Contents

1. Stars and Our Solar System

The sun, planets, moon, stars are called celestial or heavenly bodies. The sun is a star and the eight planets including the earth revolve around it in different orbits.

The Moon : The moon revolves around the earth. It is known as a satellite of the earth. It is a natural satellite of the earth. It is the heavenly body nearest to the earth. The moon is at an average distance of 3,84,400 km from the earth.

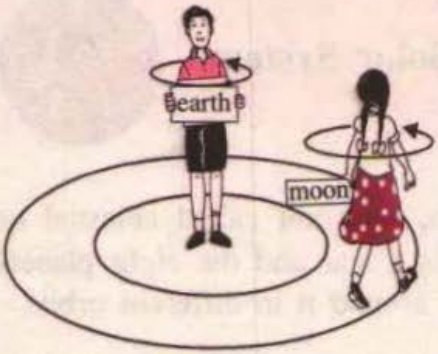
Try this : Make a chart and enter in it the time of moonrise and moonset. Make these entries every day from one Full Moon Day to the next. What do you see ?

The moon rises at a different time every day. You will notice that on any day, the moon rises about 50 minutes later than on the previous day.

As the moon revolves around the earth it also rotates around itself. The moon takes 27.3 days to complete one revolution around the earth. It takes the moon the same time to complete one rotation around itself.

What is the consequence of this ?

Try this : Draw a circle of radius 2 m on the playground. Ask a friend to stand at the centre of this circle. Now, walk along the circle so that you always face



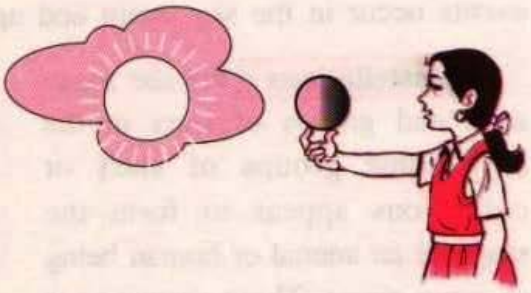
The moon's revolution around the earth

your friend. What do you notice on completing one round ? When you complete one round of the circle, you have also completed one rotation about yourself and your friend has never seen your back. That is how we only see one side of the moon.

Does the moon always appear to be of the same shape ? On Full Moon Day it appears to be round. After that it wanes or appears smaller and smaller till at last on New Moon Day we don't see the moon in the sky. From New Moon Day, the moon 'waxes' or appears bigger and bigger again, every day.

These different shapes of the moon that we see as it waxes and wanes are called the phases of the moon. Why do we see these phases of the moon ?

Try this : Take a large ball and go to a terrace or an open field about two hours before sunset. Hold the ball in your outstretched hand. Ensure that your head or any part of your body does not obstruct the sun's rays falling on the ball. Now, suppose the ball is the moon and your head is the earth. Mark the side of the moon that is facing you.



Stand facing the sun. Watch the sunlight that falls on the ball representing the moon.

Now, turn around yourself slowly. As you turn, note which parts of the ball receive sunlight during one rotation. This gives you an idea of the phases of the moon.

Besides, even though the moon ball has completed one rotation, the part with the mark was always facing you. This is what happens in the case of the moon, too.

When you stand facing the sun, the part of the 'moon' ball with the mark is in darkness. In such a position we do not see the moon in the sky. This is New Moon Day. Thereafter, due to the rotation and revolution of the earth and the moon we see the phases of the waxing moon serially till Full Moon Day. When your back is to the sun, the sun lights up the entire side of the ball facing the sun.

This is the Full Moon Day. The period from one New Moon Day to the next is of 29.5 days. These celestial events occur in the sky again and again.

Constellations : We see many stars and groups of stars in the sky. Some groups of stars or collections appear to form the shape of an animal or human being or some object. These shapes have been named in the course of time, according to the prevailing beliefs or events.

On summer nights, we can see a particular configuration of seven stars. It is called the Great Bear in English or *Saptarshi* in Marathi.

The Great Bear

The constellation called Orion, the Hunter shines very brightly in the sky. It can be easily seen on winter nights. The three stars in the middle are said to be Orion's belt. The fainter stars below it are his dagger.

If the line of the stars from the belt is extended, it leads us to a bright star called Sirius.

Though we see about 10-12 stars in the constellation Scorpius, the Antares is the brightest amongst them. The Scorpius is seen in the sky of the southern hemisphere just below the equator. How do you think the Scorpius got its name ?

Scorpius

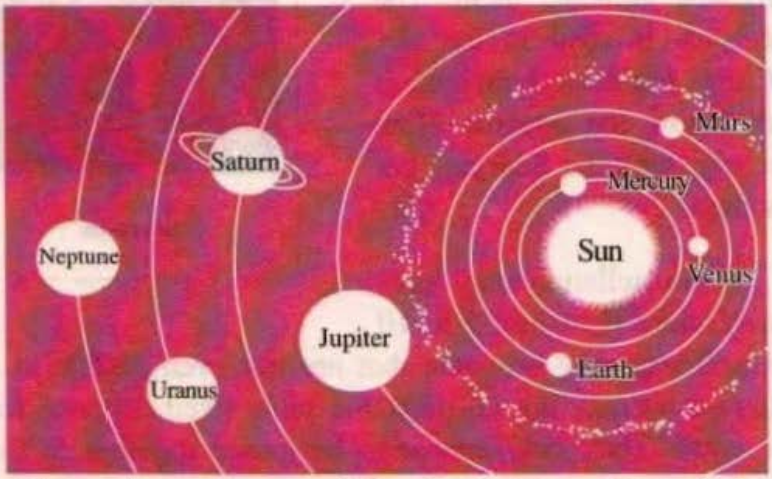
A constellation may have many more than just 5 to 10 stars. There may be some that are not even visible to us. These stars may not all be at the same fixed distance from the earth. They only appear to be joined together to form a group.

How many constellations could there be in the sky ? We have divided the sky into 88 parts. Each of these parts is known by a constellation in it. Thus, there are taken to be 88 constellations. Of these, 37 constellations belong to the northern hemisphere sky and 51 constellations belong to the southern hemisphere sky.

Ancient Indian astronomers had imagined 27 constellations which they called *nakshatras*.

- Name the 27 *nakshatras*.
- What is the importance of the Pole Star ?
- If the earth rotates from the west to the east, why do the sun and stars move from the east towards the west ?

Our solar system : The sun, the eight planets that revolve around it, their satellites, asteroids and comets all together form our solar system.



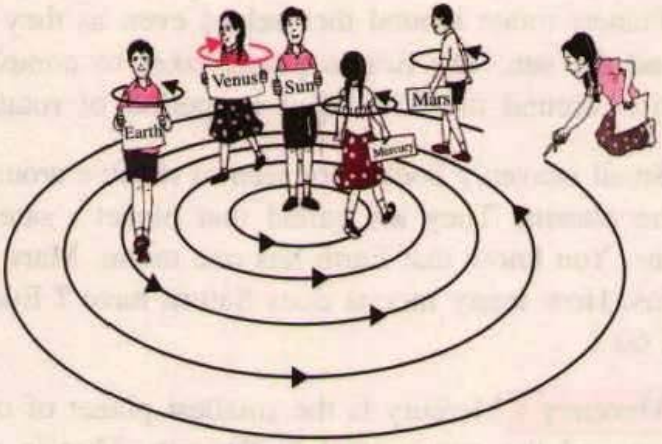
The universe is vast. Scientists believe that in it there are many other stars like our sun with their solar systems.

The sun : The sun in the centre of our solar system is a medium sized star. The temperature at its surface is about 6000°C. Its size is so big that it could hold within itself 13 lakh earths like ours. All the objects around the sun revolve around it because of its gravitational force.

The planets : Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune are the eight planets that revolve around the sun each in a different orbit.

The time taken by a planet to go once around the sun is called its period of revolution. Even though the planets have been revolving for lakhs of years, have you ever heard that any of the planets had collided with another ?

Try this : Go with your friends out into a field. Draw eight ellipses as shown in the picture. Make one of your friends stand at the centre. He is your 'sun'. Now give each of your friends a card of one of the planets, Mercury, Venus, Earth, etc and tell them to run in the proper orbit



according to the order of the planets in the solar system. The only rule for them is not to leave their orbit. Will any of your friends collide with another ?

Up to the year 2006, Pluto was considered to be the ninth and furthest planet of the solar system. However, the revolution of Pluto does not meet the criteria used by the International Astronomical Society to define a planet's revolutionary orbit. Hence, Pluto is not considered to be a planet any more. Instead, Pluto and other heavenly bodies like it are now classified as dwarf planets.

- Why should we not cut lanes when driving ?
- The earth revolves around the sun. Can it be called a satellite of the sun ?

Every planet has a different period of revolution. The greater the distance of a planet from the sun, the greater is its period of revolution. The period of revolution of Mercury is just 88 days while that of Neptune is as long as 165 years.

Planets rotate around themselves even as they revolve around the sun. The time a planet takes to complete one rotation around itself is called its period of rotation.

Small heavenly bodies are seen to revolve around some of the planets. They are called that planet's satellites or moons. You know that Earth has one moon. Mars has two moons. How many moons does Saturn have ? Even more than 60 !

Mercury : Mercury is the smallest planet of our solar system and the one nearest to the sun. That is why we cannot see it easily. However, it can be seen at sunrise or sunset on the horizon. Mercury does not have a moon.

Venus : The planet nearest to Earth is Venus. It is also called the Morning Star or Evening Star. It looks very bright early in the morning and in the evening. It does not have any moon. A peculiarity of Venus is that it rotates from east to west around itself unlike other planets which rotate from west to east. Venus, too, has phases like the phases of our moon.

Earth : The factors necessary for life such as the right temperature, water, air, atmosphere, protection of the ozone layer, etc. are found only on earth. Of all the planets of our solar system, only Earth has a living world.

The axis around which Earth rotates is not perpendicular to its orbit but slightly inclined. Because of this, Earth has seasons like summer and winter.

- Why is it difficult for us to see Mercury because of its being on the horizon ?

Mars : Mercury and Venus are called the inferior planets as their orbits are inside Earth's orbit. Those outside Earth's orbit are called the superior planets. Mars is the first superior planet. The soil on Mars is rich in iron, which makes the planet appear red. That is why it is also called the Red Planet. Mars has two moons.

Jupiter : The largest planet in the solar system is Jupiter. It is big enough to hold 1397 Earths within itself but its mass is only 318 times that of Earth. In spite of its size, Jupiter rotates very fast, completing one turn around itself in just 10 hours.

Jupiter has 63 satellites but we can see only four of them by means of a telescope.

Saturn : After Jupiter, the next planet is Saturn. Saturn has some unique characteristics. It has rings around it, although they cannot be seen by the unaided eye. Another of Saturn's special

features is its density which is less than that of water. If there were a large enough ocean of water this huge planet would float in it !

Uranus and Neptune : These planets are the outermost planets of the solar system. Hence, we cannot see them without the telescope. Like Venus, Uranus too, rotates from the east to the west. Besides, its axis of rotation is inclined at a very large angle. Hence, it appears to roll along like a ball as it revolves around the sun.

Asteroids : There is a great distance between the two planets, Mars and Jupiter. We can see small remnants of heavenly bodies revolving in this gap. They are called asteroids. Asteroids are so small that they can only be seen through a telescope.

Comets : A comet too is a celestial body. Comets revolve around the sun in elliptical orbits. But they have very long periods of revolution. A comet consists of a brilliant sphere called its 'head' and a long tail. The tail is always on the side opposite to the sun. As the comet moves nearer to the sun, the tail gets longer.

Halley's comet is seen once in 76 years. It is expected to be seen next in the year 2062.

Meteors : When some celestial body comes near the earth, the earth pulls the body towards itself. That body falls at great speed through the earth's atmosphere. As it falls, friction with the constituents of the atmosphere causes its temperature to rise and it begins to glow. This is called a meteor. A meteor traces a bright line in the sky while falling. This is often referred to as a falling star.

- Does a falling star cause damage ?
- What would happen if the earth were to pass through the tail of a comet ?

Remember : We are told of many superstitious beliefs related to seeing a comet or a falling star. Actually, these are astronomical phenomena. There is nothing ominous or evil about these events. We must not hold such beliefs ourselves. In fact, we should try to explain these events scientifically and help dispel blind beliefs.

Artificial satellites : India has put several satellites into orbits around the earth for the benefit and progress of mankind. These are artificial or manmade satellites. They orbit the earth at distances less than the distance of the moon from the earth.

India's first satellite, Aryabhatta, was put into orbit on 19 April 1975. After that, other satellites like INSAT, IRS, Kalpana-1, Edusat, Bhaskar, etc have also been launched. India has taken big strides in space science. Recently, we have simultaneously put ten satellites into orbits around the earth.

The satellites are launched by Indian Space Research Organisation (ISRO). They transmit information

to us about various places on the earth's surface. For example, on the TV in our house we can receive live coverage of a cricket match taking place in any part of the world.

Artificial satellites are useful to us in many ways. For example, they are used for –

1. Making contact with things in space and for communication.
2. Weather forecasting.
3. Telecommunications, and broadcasting programmes on radio and television.
4. Conducting space research.
5. Implementing educational programmes.
6. Making accurate maps.

Radio telescope (GMRT) : GMRT stands for Giant Metrewave Radio Telescope. The Tata Institute of Fundamental Research (TIFR) has set up this telescope close to the Pune-Nashik Highway at Khodad near Narayangaon.

The GMRT helps in the study of the solar system, its various planets and satellites and related issues.

It is the only telescope of its kind and scientists from all over the world come here to study the solar system, pulsars, supernovas, etc.

Food carried by astronauts : What do astronauts eat when travelling in space for a long period of time ? You must have also wondered how they are even able to eat in

their weightless state. In fact, like us, they have both solid and liquid foods. They have their food directly from closed packets, so that it does not fly. This food provides them with all the food constituents and vitamins they need.

Reviewing the Lesson

- There are many constellations in the sky.
- Constellations have been named after the shapes that their stars form.
- Our solar system consists of the sun, and the planets, comets, asteroids, satellites, etc that revolve around it.
- All planets rotate around themselves and revolve around the sun.
- Artificial satellites are used for communications, weather forecasting, broadcasting educational programmes, etc.

Exercises

1. Answer the following questions.

(a) What is meant by the 'rotation' of planets ?

(b) What is the special feature of Venus ?

(c) Why is Mars called the Red Planet ?

2. Give reasons.

(a) We only see one side of the moon.

(b) Planets do not collide into one another.

(c) Saturn is said to have unique characteristics.

(d) We see the planets and stars moving from the east to the west.

(e) Even as an India-England cricket match is played at Lords we can watch it live at home.

3. Fill in the blanks.

(a) There are altogether ..... constellations. Of these, 37 belong to the northern hemisphere sky and ..... to the southern hemisphere sky.

(b) Jupiter has ..... moons.

(c) ..... was India's first artificial satellite.

(d) It is because of ..... that we can forecast the weather.

4. Match the following.

'A'	'B'
(a) Morning star	1. 27.3 days
(b) The Great Bear	2. Between Mars and Jupiter
(c) IRS	3. Venus
(d) Asteroids	4. Constellation
(e) Halley's comet	5. Artificial satellite
(f) Rotation of the moon	6. 76 years

Activities

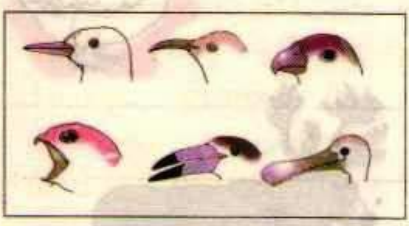
(1) Write the names of Indian astronauts and collect their pictures and information about them.

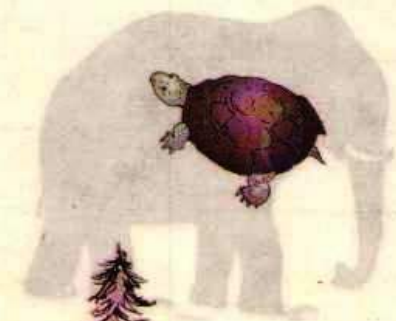
(2) Collect information about and pictures of the Chandrayaan, the spacecraft that India has sent to the moon.

(3) Find out how, when a space voyage is planned, space debris has to be taken into consideration.

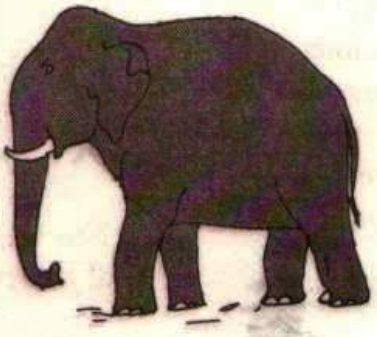
2. Biological Diversity

The variety that we see in the living things that exist on the earth is called biological diversity or bio-diversity. Thousands of species of animals and plants can be seen to exist on the surface of the earth. There is an abundance of variety in their shapes, sizes and body parts.





From micro-organisms and unicellular plants and animals to giant sized trees, vines and huge animals like the elephant and whale, there is great diversity everywhere and in all aspects of living things.



There is tremendous variation in the eating habits of different animals. Variety is also seen in the bodily systems, species and in the factors that transmit chromosomes from one generation to the next in all these plants and animals.

There is also much variety in the body structure, life patterns and habitats of species that belong to the same class. As an example, let us consider the class of animals called 'pisces' which includes fish of all kinds. Some species of fish live in fresh water while some live in the saline sea water. Some fish are tiny while others are giant-sized. Some fish use their tail fin only to change direction while others also use it as a weapon to defend themselves. Some fish have a short life-span while some have longer life-spans. Thus, we see variety in the body structure, habitats, and life patterns of fish even though all kinds of fish belong to the same class.

Environment is also an important factor that brings about this biological diversity.

In any geographical region, the environment changes from place to place and also in the course of time. That is why there is variation even in those living things which live in the same environment. Aquatic living things whether they live in ponds, rivers, lakes or seas, all show a great amount of variety.

Animals that live in deserts and the plants that grow there are different from those found in coastal areas.

Animals and plants belonging to snowbound regions differ from those of flat plains.

The importance of the conservation of bio-diversity : The needs of all living things including those of human beings are met because of the diversity of life-forms. That is why bio-diversity is important for the existence of living things. Our basic necessities of food, clothes and shelter, and other important necessities like medicines are met only because of bio-diversity.

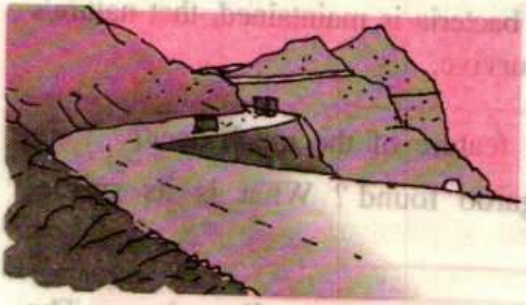
Environmental importance : Imagine that in a forest, tigers are the only animals left. There are no herbivorous animals left that the tigers feed on. What will the outcome be ? Obviously, the tigers will starve and their number will dwindle due to starvation. It means that the predators will not be able to live on in the absence of their prey. This shows how necessary it is for the prey-predator links in nature to continue because, as we have seen, if any one of these dies out the other too is sure to die. In short, it is only if the balance between the number of plants which are producers, and the number of herbivores, carnivores, as also of decomposers such as bacteria is maintained, that nature's chain can continue to survive.

- What is the special feature of the musk deer?
- Where is the kangaroo found ? What is its special feature ?

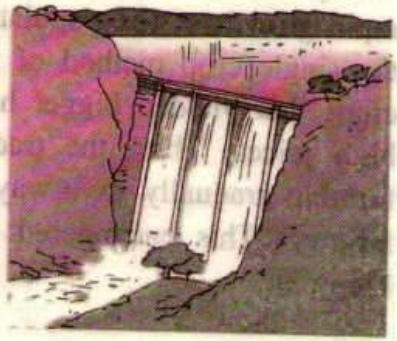
Reasons for the decline in bio-diversity : The explosive rate at which the population of our country is growing is the main reason for the decline in bio-diversity. The demand for foodgrains increased in keeping with the rapid growth of the population. So, farmers began to use the single crop method of farming. They began to grow crops that yielded bigger harvests and could be sold for high prices. Thus, the traditional method of multi-crop farming gradually gave way to the practice of single crop farming. This endangered the bio-diversity in the plant kingdom.

In the case of animals too, hybrid and imported breeds have replaced the local varieties of cattle. With the entry of these foreign breeds, the local ones are now threatened.

Besides, certain species of plants are being cut and certain animals are being hunted. As a result, the types of animals and their numbers have dwindled. Some species have become endangered, some have become rare and some have even become extinct.



The demand for land for housing has increased manifold. As a result, land, which once had abundant forest wealth has been cleared by cutting away the vegetation from it. The colonies being built for people on this land are constantly growing in number.



Activities such as huge construction works of dams, roads, factories, etc, as also mining, not only cause unbridled consumption of natural resources, but also

destroy habitats rich in bio-diversity. This is another reason why bio-diversity is threatened.

Pollution in the environment is another cause for the disappearance of many species. The rising temperature of the earth can prove dangerous for some rare and sensitive species that can only survive in certain specific conditions. Large scale changes can take place in natural habitats as a result of changes in the climate.

These and many other such reasons are responsible for the decline in bio-diversity. To conserve bio-diversity, it is necessary to protect and conserve endangered species.

- What are the uses of the *chandan* (sandalwood) tree ?
- What priceless treasure do adivasis possess ?

Protection of rare species : Laws have been made to help protect plants and animals of rare species. Various other measures are also being undertaken. Some of them are given below :

- Creating National Parks and Sanctuaries.
- Declaring some areas as Reserved Bio-diversity Zones.
- Undertaking special projects to nurture specific species.
- To nurture some species of animals and plants in zoological or botanical gardens, respectively.
- To compile and document traditional knowledge.

Efforts to protect knowledge related to bio-diversity have already begun. Emphasis is now being placed on protecting and nurturing bio-diversity by obtaining people's participation for the same.

Local species show many characteristics such as resistance to disease, survival in adverse conditions, shorter life-cycles. These species can be crossed with new ones to get the advantages of these characteristics. However, for this purpose, strains of the local varieties must be preserved carefully. **Seed banks** have now been started for this very purpose. There are **gene banks** for preserving the genes of local varieties. All this has become possible due to advances in the field of **bio-technology**.

Reserved bio-diversity zones : In these areas, the wildlife is protected but the local people are permitted to carry on with their daily life and work.

A treaty for protecting plants and wild animals in danger of extinction because of international trade has come into force since 1975. This treaty regulates the import and export of all kinds of wildlife.

At the Earth Summit held at Rio-de-Janeiro in Brazil, in 1992, a treaty for the protection of bio-diversity was adopted. The treaty emphasizes the need for nurturing bio-diversity.

Reviewing the Lesson

- The great variety of living species we see is referred to as bio-diversity.
- There is variation in living things with respect to their sizes, shapes, eating habits, body parts, life-cycles, etc.
- There are differences in individuals of the species with respect to body structure, life patterns, habitats, etc.

- Living things live in diverse environments.
- The reasons for the decline in bio-diversity are : very large human population, greater demand for land for building shelters and for foodgrain production, unrestricted use of natural resources, etc.
- Various efforts are being made to protect and conserve endangered species.

Exercises

1. Write answers to the following questions.

(a) What is meant by bio-diversity ?

(b) What is the importance of bio-diversity ?

(c) In which respects do living things differ ?

(d) What are the different reasons for the reduction of bio-diversity ?

(e) List the various efforts being made to protect endangered species.

2. Give reasons.

(a) It is very important to preserve the prey-predator chains.

(b) The single crop method can prove harmful.

3. Write notes.

(a) Importance of the environment

(b) Bio-technology

(c) Reserved Bio-diversity Zones.

Activities

(1) Collect pictures of different varieties of the same flower. (rose, hibiscus, oleander)

(2) Collect pictures of butterflies, paste them in a scrapbook and observe the diversity.

(3) Go to the fish market and observe the diversity in fish.

(4) Find out what precautions must be taken when using the new type of cotton seeds (BT cotton) available in the market, for planting cotton.

(5) List the measures that can be undertaken for preserving the disappearing bio-diversity.

3. Atmospheric Pressure

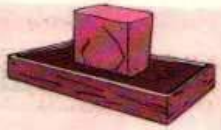
You know that force is required to move a stationary object, to stop a moving one or to change the direction of an object in motion. You also know that force is required to change the speed of an object or to change its shape.

When a force is applied to an object, is the effect on that object always the same ?

Try this : Take a brick that is used in construction work. Observe its length, breadth and thickness carefully. Generally, the breadth of a brick is twice its thickness and the length is twice its breadth. In a wooden crate, fill soil up to a height of about 30 cm. Pour water into it to make a layer of thick mud.

Place a brick gently on this mud so that it gets embedded in the mud. Now, remove the brick and observe the imprint on the mud. Now, place the same brick vertically on the mud a little away from its earlier place.

Again, observe how deeply the brick embeds itself in the mud. What do you observe ?



When the brick is placed horizontally, the area on which it rests is large and the brick sinks only a little. However, when it is placed vertically, the area on which it rests is smaller and it sinks deeper. How can we explain this ?

When a force is applied to an object, the effect produced on that object depends on the area of the surface on which the force is acting.

The greater this surface area, the smaller is the effect produced by the force.

Pressure : Force applied on unit area is called pressure.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

People use long and broad planks for skiing on snow. Due to boards of this type, the effect of the force applied by the boards is reduced and it becomes easier to ski.

The unit of force is a Newton while that of area is square metre or m^2. Hence, the unit of pressure is Newtons per square metre, (N/m^2).

Thus, we see that increasing surface area decreases pressure, while more pressure is felt if the area is small.

Try this : Take a nail which has a flat head and a sharp tip at the other end. Can you hammer the nail into the wall by holding the flat head on the wall ? No, you cannot. You

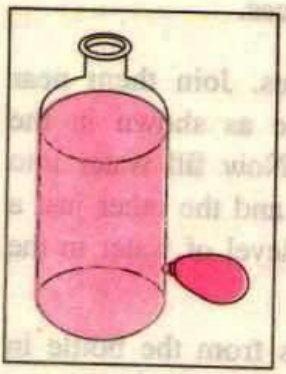
can only do it by holding the pointed side against the wall. Why is that ?

The area of the flat head is greater while that of the pointed end is relatively very very small. As a result, the force applied on the flat head is concentrated on to a very small area producing greater pressure and the nail goes in easily. Needles and knives have sharp points or edges. This makes the actions of piercing or cutting easier by helping us to produce greater pressure on a small area.

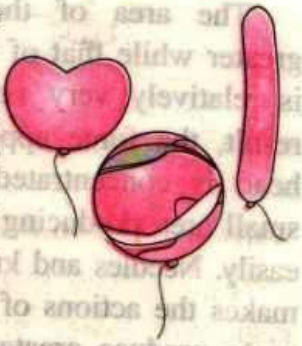
- Why do school bags have broad shoulder straps ?
- Why do porters place the load they have to carry, on a roll of cloth rather than directly on their head ?

Do substances in the liquid or gaseous state exert pressure ?

Try this : Take a plastic bottle. Pierce a hole into its side near its base as shown in the figure. Fit a narrow glass tube of length 1 cm into this hole. You could make this hole easily by using a hot iron nail for the purpose. Fit a piece of a thin rubber over the mouth of the tube and slowly fill the bottle with water. As water collects in the bottle, the piece of rubber bulges and gradually grows bigger and bigger. This tells us that the water exerts pressure on the walls of the bottle.



Why does the pressure increase even though the area of the tube remains the same ? Although the area remains unchanged, the mass of the water increases. Therefore, the force increases and so does the pressure.



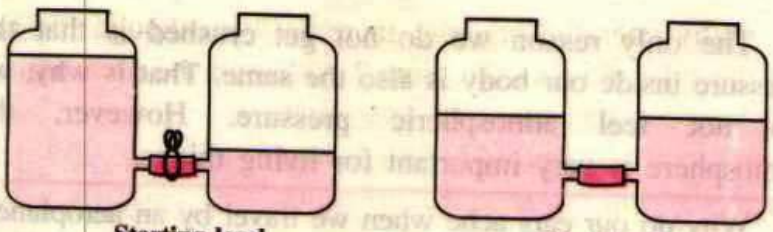
As you blow more and more air into a balloon, its size increases. If you blow it up beyond a point, the balloon bursts. It means that like liquids, gases also exert pressure on the walls of their containers.

We get balloons of many different shapes. If air is filled in a round or oval balloon or one of any other shape, the balloon takes that shape. When you fill your bicycle tube with air, does the tube retain its tube-like shape throughout or does it get a different shape near the nozzle ? Air and water are fluid (i.e. flowing) substances. Fluid substances exert pressure equally in all directions. That is why they give uniform shapes.

Exerting equal pressure in all directions is an important property of fluid substances.

Try this : Take two plastic bottles. Join them near their base by means of a rubber tube as shown in the figure. Close the tube with a clamp. Now fill water into both bottles. Fill one bottle completely and the other just a little above the rubber tube. Watch the level of water in the two bottles. What do you see ?

Now, open the clamp. Water flows from the bottle in



which the level of water is higher, into the other where the level is lower. The flow of water stops when the level of water in the two bottles becomes equal.

Fluids flow from a region of higher pressure to a region of lower pressure.

- Why is a fountain of water seen rising out of a leaky pipe ?
- When does river water start flowing ?

Atmospheric pressure : You know that we are surrounded by the atmosphere. You can easily understand that as the atmosphere is made up of gases such as nitrogen, oxygen, water vapour, etc, it must have mass. The atmosphere extends to hundreds of kilometres around the earth. The pressure that the atmosphere exerts is called atmospheric pressure.

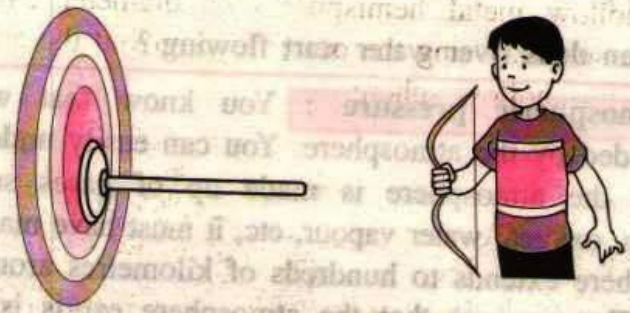
Considering that the atmosphere extends to hundreds of kilometres, imagine a very tall cylindrical column exerting pressure on unit area. What will this atmospheric pressure be ?

The mass of the atmosphere standing on a 10cm × 10cm area is as tremendous as almost 1000kg. How do we survive, carrying such a tremendous weight on our head ?

The only reason we do not get crushed is that the pressure inside our body is also the same. That is why, we do not feel atmospheric pressure. However, the atmosphere is very important for living things.

- Why do our ears ache when we travel by an aeroplane ?
- Why and in which direction do land breezes blow ?

Try this : Rubber suckers that stick tightly on glass surfaces are available in the market. Observe them carefully. When properly pressed on the glass, they stick to it. They are difficult to pull away from the glass.



Why is this so ? When the sucker is pressed on to the flat glass surface, the air between the sucker and the glass is pushed out. As a result, there is very little or no atmospheric pressure there. However, the atmospheric pressure outside pushes the sucker in. This makes it stick tightly to the glass and it becomes difficult to pull it away.

Try this : Take a can made of thin metal sheet, with a screw-on lid. Pour a little water in it and heat the can. In a little while, the water begins to boil and form steam,

which rises out from the can. As the steam leaves the can, it also pushes out the air that was present in it earlier. After some time, close the lid tightly and allow the can to cool down. What do you see ? After some time, the can gets crushed from all sides. Why does this happen ? Think about it. Do this experiment under the supervision of an adult.

Air pressure is the same on all sides.

Otto von Guericke was a German scientist who lived in the 17th Century. He had invented a pump which he could use to suck out the air from a closed container. He conducted an experiment in which he joined together two hollow metal hemispheres of diameter 51cm to form a sphere. Using the pump he removed the air from inside this hollow sphere.

Then he tried very hard to pull the two hemispheres apart but couldn't do so due to atmospheric pressure. Even when he used eight horses to pull at each of the hemispheres, he could not separate them. The strength of so many horses was found wanting when compared to atmospheric pressure !

You can do this simple experiment to experience atmospheric pressure for yourself.

Fill a glass with water to its brim. Cover it with a square of stiff card paper. Holding the paper in place with your hand, turn the glass upside down. Now carefully take your hand away from the paper. What happens ?

The water in the glass does not spill. Why is that ? The atmospheric pressure outside presses the paper upwards. Compared to this pressure, the pressure of the water in the glass is less. That is why, the water does not spill.

- Why does a cool breeze blow in the afternoon on the seashore ?
- Why do we pucker our lips when blowing out a candle ?

Pumps : You must have seen an ink dropper. It has a rubber bulb at one end while the other end tapers to a narrow opening. We dip the narrow open end into the ink. On pressing the bulb, the air in it is pushed out of the opening. This reduces the pressure of the air in the bulb. There is atmospheric pressure acting on the surface of the ink in the pot. It pushes the ink into the dropper tube. Now, we take out the dropper and hold its opening over the open barrel of the pen. When we press the bulb again, the ink in the tube is pushed out into the pen.

How much ink collects in the dropper ? Ink enters the dropper till the pressure of the air in the dropper becomes equal to the atmospheric pressure outside acting on the ink in the bottle. It is because these two pressures are equal that the ink does not fall out of the dropper unless we press the bulb. Thus, it is clear that the dropper is a kind of pump.

- Why is the opening of a dropper very narrow ?
- What is the characteristic of the cap of eye drop bottles ?

The spray pump : The spray we use for spraying *Holi* colours is a kind of pump. It consists of a plastic or metal cylinder with a narrow tube at one end and a lid at the other. Inside the cylinder is a snugly fitting piston which can be moved up and down inside the cylinder with the help of a rod which passes through a hole in the centre of the lid.

The narrow end of the pump is held under the water or any other liquid and the piston is pushed in up to the bottom thus pushing out all the air from the cylinder through the narrow tube. This reduces the pressure there. Now the piston is pulled up. This causes the liquid to rise into the part of the cylinder below the piston. Now, as the pressure of the water inside is equal to the atmospheric pressure outside, the water does not fall out. To spray the water or the colours, the piston is pushed in. Under this greater applied pressure, the liquid gushes out of the narrow tube.

- What is the difference between the ink dropper and the spray pump ?
- How does the doctor's syringe work ?

Air brakes : Air brakes are used in trucks, buses, trailers, railway trains, smaller vehicles, aeroplanes, etc. George Westinghouse invented air brakes and first used them on 5th March 1872 for the railway train.

The air brakes consists of a cylinder filled with air and connected to the front as well as rear wheels of the vehicle. When the driver presses the brake pedal the air in the cylinder gets compressed and its pressure increases. This causes the brake shoes to rub against the moving wheels and the friction reduces the speed.

Reviewing the Lesson

- Force applied to unit area is called pressure.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

- The unit of pressure is Newtons per square metre (N/m^2).
- Fluid substances like liquids and gases exert pressure on the walls of their container.
- The atmosphere around our body exerts pressure on it.

Exercises

1. Answer the following questions.

(a) Why do knives and blades have sharp edges ?

(b) Why are ski-boards that are used to glide over snow long and broad ?

(c) Why does ink not spill out of an ink dropper ?

2. Fill in the blanks.

(a) The unit of pressure is ..... .

(b) Ink rises into the ink dropper because of the ..... pressure acting on the surface of the ink in the bottle.

(c) When the piston of a pump is pulled up, the pressure inside ..... .

(d) The air pressure inside our body is equal to the ..... .

3. Match the following.

'A'	'B'
(a) Fluid substances	1. Greater pressure
(b) Sprinkle irrigation	2. Equal pressure in all directions
(c) Blunt weapon	3. Pressure on water
(d) Sharp weapon	4. Less pressure

4. Are the following statements true or false ?

(a) The pressure of air inside an inflated balloon is equal to atmospheric pressure.

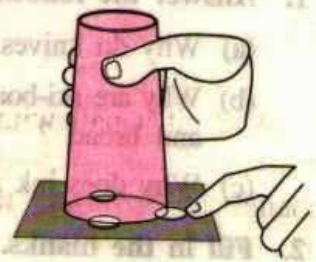
(b) Fluids always flow from higher pressure to lower pressure.

(c) If area is reduced, pressure is reduced.

(d) Standing on a cane chair increases the possibility of the cane breaking due to increased pressure.

Activity

Carry out this simple experiment to test the strength of atmospheric pressure.



Fill a glass with water. Place a dish on it upside down. Holding the dish in place with your hand, turn the glass over. Place the dish on a table.

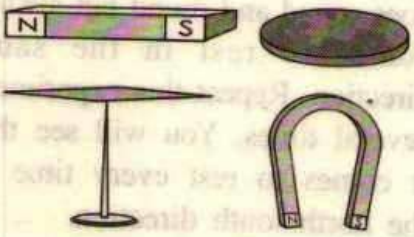
Take a few 50 paisa coins. Slide one coin under the edge of the glass without disturbing the water even slightly. Now, slide a second and third coin under the glass in the same way. You will see something remarkable. The glass is standing on three coins but the water inside does not spill out ! This is the magic of atmospheric pressure. With practice, you will learn to do this experiment quite easily. Then you will even be able to make the glass stand on piles of coins without spilling all the water ! Try it, have fun !

4. Magnetism

You hit a ball with your bat to score a boundary, you turn the handle-bars of your bicycle with your hands to change its direction. In these cases, there is contact with the object on which force is applied. Can we apply any other kind of force ?

When a ripe fruit falls to the ground, we see the force of gravity acting on the fruit. **There was no contact between the earth and the fruit, yet force was applied.** When a comb has been rubbed on dry hair it can pick up pieces of paper without touching them. You know that this is because of the static electric force. In the same way, **magnetic force too, can be applied even if there is no contact.** It is said that about 600 to 800 BC the people living in Magnesia in Asia Minor found a stone which could pull or attract iron towards itself. They gave this stone the name magnetite which, with time, has changed to magnet. The properties of this stone were studied further and this gave rise to the science of magnetism.

Nowadays, magnets of different shapes such as bar magnets, disc magnets, horseshoe magnets and magnetic needles are available in the market.



Try this : Take small pieces of iron, zinc, coal, aluminium, cobalt, nickel and copper in a dish. Place a bar magnet in this dish. What do you see ?

The pieces of iron, nickel and cobalt are attracted towards the magnet. But the pieces of the other metals and non-metals are not attracted towards the magnet. Is wood attracted to a magnet ?

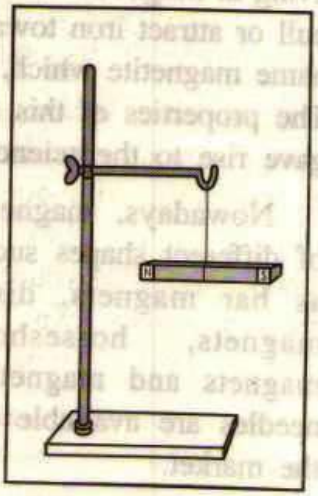
Substances that are attracted to a magnet are called magnetic substances, for example, iron, nickel and cobalt.

Those substances that remain unaffected by a magnet are called non-magnetic substances, examples of which are plastic, rubber and copper.

- A bar magnet was placed deep inside a sack of coal. Fine particles of coal got stuck to it. From this, can we infer that coal is attracted towards a magnet ?

Properties of a magnet :

Try this : Tie a thread to a bar magnet at its centre and suspend it from a wooden stand as shown in the figure. You will see that the magnet, if disturbed, goes round and round but always comes to rest in the same direction. Repeat this experiment several times. You will see that it comes to rest every time in the north-south direction.

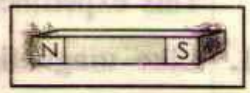


Coming to rest in the north-south direction when freely suspended is one of the characteristics of a magnet.

A magnet always has two 'poles'. The pole that points towards the north of the earth is called the magnet's north pole and the one pointing to the south is called the south pole. The ends of a magnet are clearly marked N and S for North and South, respectively.

- Where are the poles of a disc magnet located ?
- What will you see if the above experiment is done using a coir rope ?

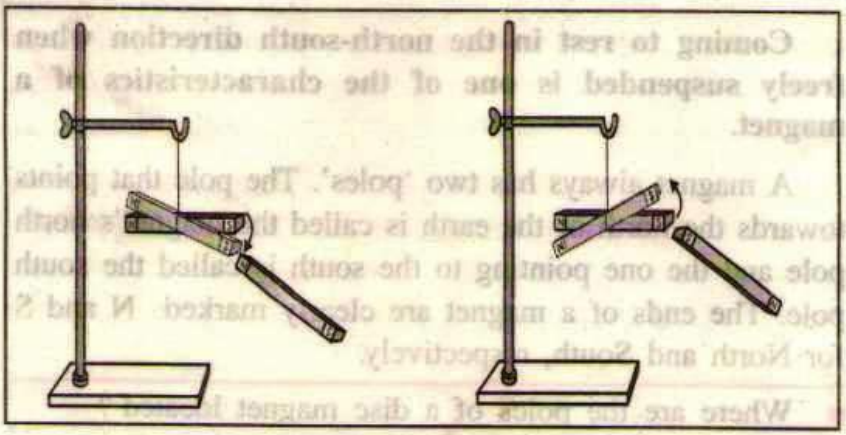
Try this : Take some iron filings in a dish. Place a bar magnet in it. Now, lift the magnet. What do you see ? The iron filings stick to the magnet but cluster around the poles rather than the middle portion of the magnet.



Thus, we can easily see that the magnet's strength is concentrated at its poles.

Try this : As shown in the figure, suspend a bar magnet from a wooden stand by means of a thread. Allow it to come to rest in the north-south position. Bring the north pole of another magnet close to the north pole of the suspended magnet. What do you see ? The north pole of the suspended magnet moves away from the north pole of the other magnet. This phenomenon is called **magnetic repulsion.**

Now, take the other bar magnet away. Allow the suspended magnet to come to rest. Now bring the south pole of the bar magnet near the north pole of the suspended



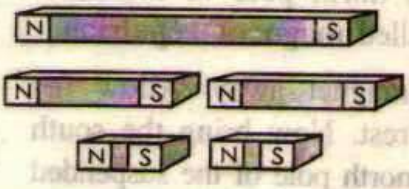
magnet. The two poles are attracted towards each other. This is called **magnetic attraction.**

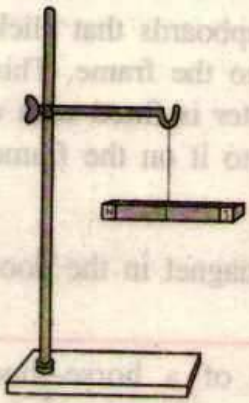
This experiment shows us two properties of magnets.

1. **Like magnetic poles repel each other.**
2. **Unlike magnetic poles attract each other.**

- In the above experiment, what will you observe if the poles were interchanged ?
- What difference will you see if an iron bar were suspended in place of the bar magnet ?

Try this : Take a thin bar magnet which you could cut with scissors. Mark its north and south poles. Cut the magnet at its centre. Place both pieces in a dish of iron filings. You will find that the iron filings cluster around the ends of each magnet. Also, suspend the pieces freely and test for the north and south poles. You will find that both





pieces come to rest in the north-south direction. Repeat this experiment cutting the magnets into smaller and smaller pieces every time. You will observe that each piece has these same properties. It means that no matter how small you cut the magnet, each piece will have both the north pole and south pole.

Thus, the two poles of a magnet cannot be separated from each other.

Uses of magnets : In ancient times, sailors on the high seas looked at the positions of stars and planets in the sky to determine directions. They identified the north by locating the Pole Star or North Star in the sky. Later, when the property of the magnet of coming to rest in the north-south direction was discovered, a magnet came to be used in the compass to tell directions. Chinese and Greek sailors were the first to make a mariner's compass using a magnet. At that time, a magnetic needle supported on a wooden block would be floated on water. As the needle was free to turn, it would come to rest in the north-south direction.

A pin holder used on a writing table is usually made of plastic. When you turn the pin holder over, the pins at its bottom stick to the inside of the mouth of the holder. Then they can be easily picked out. A thin round magnet is fitted in the mouth. That is why, the iron pins stick to the lid.

You might have seen shutters of cupboards that click shut tightly as they are brought close to the frame. This happens because the bottom of the shutter is fitted with a magnet and the point exactly opposite to it on the frame is fitted with an iron strip.

Observe this : Find out how the magnet in the door of a refrigerator works.

- What are the special advantages of a horse-shoe magnet ?

Reviewing the Lesson

- Iron, nickel and cobalt are magnetic substances.
- Coming to rest in the north-south direction, having maximum magnetic strength at the poles are some characteristics of magnets.
- There is attraction between unlike poles and repulsion between like poles of magnets.
- Magnets have many household uses as in magnetic door closers, refrigerators, pin holders, etc.

Exercises

1. Answer the following questions.

(a) Classify the following substances as magnetic or non - magnetic.
copper, phosphorus, iron, cobalt, soil, water, silver, mercury, nickel, wood, oil.

(b) In olden times, how was a magnet placed in a compass ?

2. Match the following.

'A'	'B'
(a) Compass	1. Maximum magnetic strength
(b) Cupboard	2. Like poles
(c) Repulsion	3. Bar magnet
(d) Magnetic poles	4. Magnetic needle

3. Fill in the blanks.

(a) There is magnetic ..... between like poles.

(b) Stainless steel is a ..... substance.

(c) There is mutual attraction between ..... poles of magnets.

(d) There is maximum magnetic force near the ..... of a magnet.

4. Give reasons.

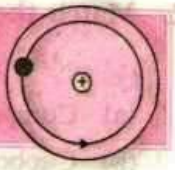
(a) A magnetic needle is used in a mariner's compass.

(b) If a bar magnet is suspended vertically it does not hang in the north-south direction.

Activity

Take a paper clip. Tie a fine black thread to it. Tie a knot to the other end of the thread and stick it to a table top. Now, bring a bar magnet above the clip. The magnet will lift the clip. Keep raising the bar magnet gradually. The clip, too, will rise till the thread becomes straight. If the magnet were hidden what would you see ? A clip that hangs in mid-air !

5. The Structure of an Atom



Every substance is made of atoms. The atom of any substance is ordinarily neutral. That is, it has no electric charge. This is because the number of positive electric charges and negative electric charges on an atom are equal. How is it possible for opposite charges to exist in the same atom ? Many scientists have studied the structure of the atom and advanced their theories about it. The theories proposed by Dalton, Thomson and Rutherford are given below.

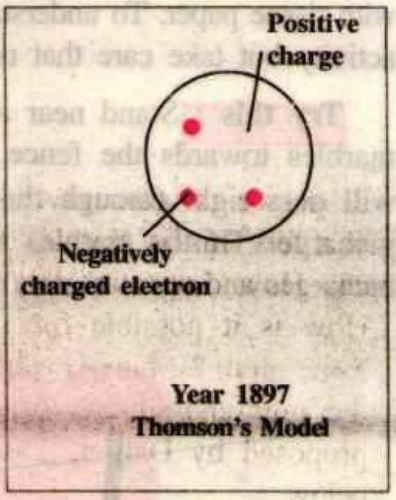
Dalton's atomic theory : The English chemist John Dalton proposed the atomic theory in the year 1808. His theory is considered to be the fundamental theory about the composition of matter. He proposed that matter consists of very small particles which he named atoms. An atom is a hard, solid ball and it is indivisible.

A hard and solid ball

Dalton's Model
Year 1808

Dalton's theory does not propose anything about the positive and negative charges on an atom. Hence, it was not able to explain many of the properties of substances.

Thomson's theory : In 1897, J. J. Thomson, the British physicist, proposed a different theory. He compared an atom to a watermelon.



A watermelon has a red edible part. In it, black seeds are embedded. Thomson's theory proposed that the atom has a positively charged part like the red part of the watermelon and in it are embedded, like the seeds, negatively charged particles which he called electrons. According to this theory, as the positive and negative charges are equal, the atom as a whole does not have any resultant charge.

Thomson's greatest contribution was to prove by experimentation the existence of the negatively charged particles, or electrons, in an atom. For this discovery, he was awarded the Nobel Prize in 1906. Although this theory explained why an atom is neutral, it was an incomplete theory in other ways.

Rutherford's theory : To better understand the shortcomings of Thomson's theory, Earnest Rutherford conducted an experiment. He bombarded a very thin layer of gold with positively charged alpha (α) rays. He found that most of these rays which travel at a great velocity passed through the gold sheet without encountering any obstacles. A few are, however, turned back from the sheet.

Rutherford considered this remarkable. In his words, it was as miraculous as if a bullet had turned back after colliding with tissue paper. To understand this, carry out the following activity but take care that no one gets hurt as you do it.

Try this : Stand near a barbed wire fence and throw marbles towards the fence. A majority of these marbles will pass right through the fence to the other side. But, just a few of the marbles will hit the wire and be turned back. How do we explain this ? There is a lot of space

between two wires of a fence. Hence, it is most likely that the marbles will pass through. However, those that return, point to the existence of the wires in between.

Based on this experiment, Earnest Rutherford proposed his famous theory. In his opinion - (1) The fact that most alpha particles pass through the gold sheet means that the atom consists mainly of empty space. (2) The part from which the positively charged particles are turned back is positively charged but very small in size as compared to the empty space.

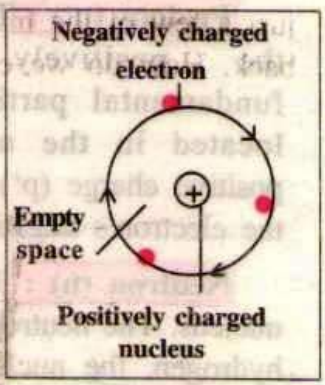
From these inferences, Rutherford presented his theory of the structure of atoms. For this theory, he was awarded the Nobel Prize for chemistry.

Rutherford's theory proposes that :

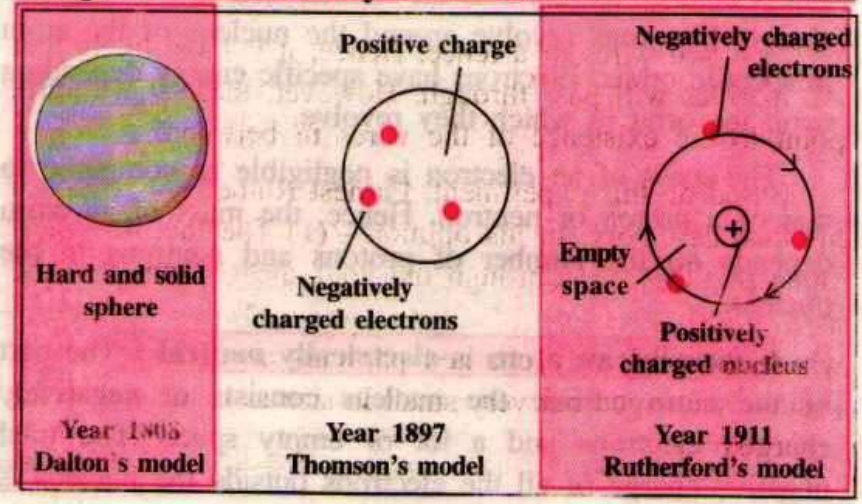
(1) The nucleus at the centre of the atom has the positive charge. Most of the mass of the atom is concentrated in the nucleus.

(2) The negatively charged electrons revolve around the nucleus in specific orbits.

(3) In comparison with the size of the atom, the nucleus is very very small.

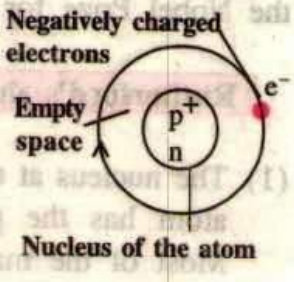


Stages of the discovery of the constituents of an atom



Protons, neutrons and electrons are the fundamental particles in the structure of the atom.

Protons and neutrons are the two types of particles in the nucleus of an atom. They are called nucleons.



Protons (p^+) : The proton is the positively charged fundamental particle and is located in the nucleus. Its positive charge (p^+) is of the same magnitude as that of the electron's negative charge.

Neutron (n) : This fundamental particle (n) is in the nucleus. The neutron does not have any charge. Excepting hydrogen, the nuclei of all atoms contain neutrons. The mass of a neutron is approximately equal to that of a proton.

Electron (e^-) : This is a negatively charged particle and is denoted as (e^-). e^- is the fundamental unit of negative charge. Electrons revolve around the nucleus of the atom in specific orbits. Electrons have specific energy depending upon the orbit in which they revolve.

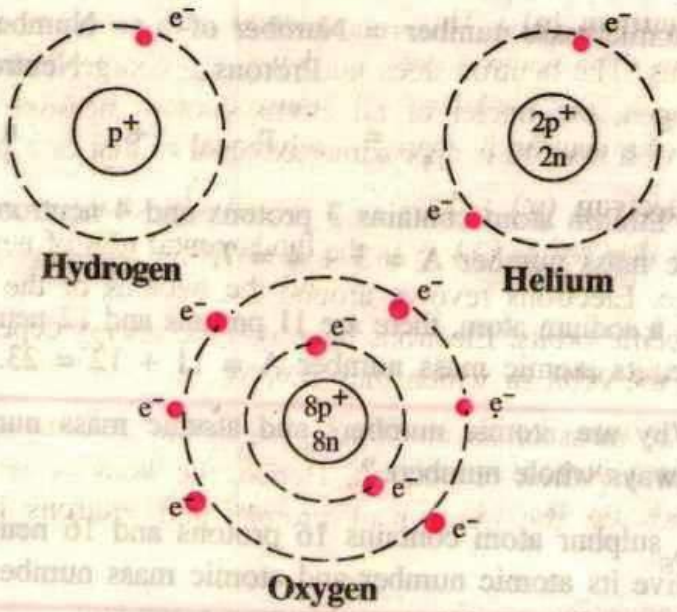
The mass of an electron is negligible as compared to that of a proton or neutron. Hence, the mass of an atom depends on the number of protons and neutrons in the nucleus.

Generally, an atom is electrically neutral : The part of the atom outside the nucleus consists of negatively charged electrons and a lot of empty space. The total negative charge of all the electrons outside the nucleus is

equal to the total positive charge in the nucleus. That makes the atom electrically neutral.

- Is the structure of the atom the same as the structure of the solar system ?
- The planets of the solar system revolve around the sun due to gravitational forces. Which force acts in the atom ?
- What is the function of the neutrons in the nucleus ?

Atomic number : The number of electrons or protons in an atom is called the atomic number of that atom. It is represented by the letter Z. If you know the atomic number of an atom, you know the number of electrons or protons in it.



Look at the figures. The hydrogen nucleus has one proton around which revolves one electron. It means that its atomic

number Z = 1. In the helium atom, there are two protons and two neutrons. As there are two electrons in orbit around the nucleus, the atomic number of helium is Z = 2.

Look at the atomic structure of oxygen shown in the figure. What is its atomic number Z equal to ?

- If the atomic number of carbon is (Z = 6), what is the number of the electrons revolving in its atom ?

Atomic mass number : We have seen that the mass of an atom is concentrated in its nucleus. From this, we can get the atomic mass number. Atomic mass number (A) is equal to the sum of the number of protons (p) and neutrons (n) in the nucleus.

Atomic mass number = Number of Protons + Number of Neutrons

A = p + n

A lithium atom contains 3 protons and 4 neutrons. Its atomic mass number A = 3 + 4 = 7.

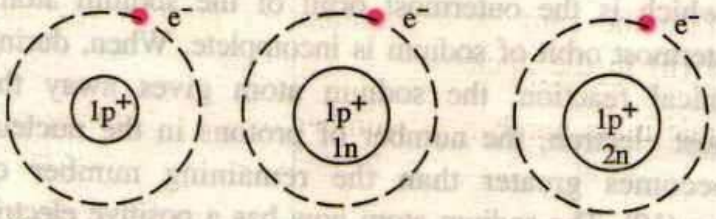
In a sodium atom, there are 11 protons and 12 neutrons. Hence, its atomic mass number A = 11 + 12 = 23.

- Why are atomic numbers and atomic mass numbers always whole numbers ?
- A sulphur atom contains 16 protons and 16 neutrons. Give its atomic number and atomic mass number.

When writing the symbol of an element, its atomic number and atomic mass number are also written. For

example, the symbols of hydrogen, carbon and oxygen are written as ${}_{1}^{1}H$, ${}_{6}^{12}C$, ${}_{8}^{16}O$ respectively.

Isotopes : In nature, in the case of certain elements, we find some atoms which have the same atomic number but a different atomic mass number. Such atoms of an element are called isotopes of that element. The nuclei of the atoms of different isotopes of an element have the same number of protons but a different number of neutrons. For example, hydrogen has three isotopes.



Hydrogen ${}_{1}^{1}H$ Deuterium ${}_{1}^{2}H$ Tritium ${}_{1}^{3}H$

Another example of isotopes is that of carbon. They are ${}_{6}^{12}C$ and ${}_{6}^{14}C$. Similarly, ${}_{17}^{35}Cl$ and ${}_{17}^{37}Cl$ are the isotopes of chlorine.

Generally, all isotopes of an element have the same chemical properties. However, some isotopes have special properties. Therefore, these have some practical applications. Examples :

1. Isotopes of uranium are used as fuel in atomic reactors.
2. Isotopes of cobalt are used in the treatment of cancer.
3. Isotopes of iodine are used in the treatment of goitre.

Formation of ions : Electrons revolve around the nucleus in specific orbits. Of these, the electrons in the outermost orbit take part in chemical reactions. If the outermost orbit is incomplete, that is, if it can hold more electrons, then there is the possibility of the give and take or sharing of electrons during a chemical reaction.

During a chemical reaction, metals tend to give and non-metals tend to receive electrons. For example, a sodium atom has 11 electrons of which two are in the first orbit and 8 in the second. One electron is in the third orbit, which is the outermost orbit of the sodium atom. The outermost orbit of sodium is incomplete. When, during a chemical reaction, the sodium atom gives away the outermost electron, the number of protons in the nucleus (11) becomes greater than the remaining number of electrons (10). The sodium atom now has a positive electric charge.

$$Na \longrightarrow Na^{+} + e^{-}$$

The sodium atom gives away one electron.

Like sodium, magnesium, a metal, also becomes positively charged.

$$Mg \longrightarrow Mg^{2+} + 2e^{-}$$

On the other hand, a chlorine atom has 17 electrons. Of these, 2 are in the first orbit, 8 in the second and seven in the third orbit. Thus, the outermost orbit of chlorine is incomplete. To complete it, it must receive one electron. When it does so, the number of protons in the

nucleus becomes less than the number of electrons by one and the chlorine atom gets negative electric charge.

$$Cl + e^- \longrightarrow Cl^-$$

The chlorine atom receives one electron.

Like chlorine, the oxygen atom too becomes negatively charged.

$$O + 2e^- \longrightarrow O^{2-}$$

Thus, **ions are formed by the give and take of electrons**. In the aluminium atom, there are three electrons in the outermost orbit. How will the aluminium atom form an ion ?

Valency : Every element has a definite capacity for combining with other elements. This capacity of an element for combining is called the valency of that element.

The valency of any element is compared with that of hydrogen which is considered to be one. The valency of an element is always a whole number.

Sodium and potassium have a valency equal to that of hydrogen. Hence, they have the same valency of one. Oxygen and calcium have a combining capacity twice that of hydrogen. Hence, their valency is 2. The valency of nitrogen is 3 and that of silicon is 4.

- The gas argon does not take part in chemical reactions. What do you think is its valency ?
- How many electrons could there be in the outermost orbit of the atom of an element whose valency is 2 ?

When atoms of different elements combine with each other then molecules of compounds are formed. In these instances, it is necessary to know the valencies of those elements. Study the following examples :

(1) $2Na + Cl_2 \longrightarrow 2NaCl$

Valency 1 1

Here, the valencies of both sodium and chlorine are 1.

(2) $Mg + Cl_2 \longrightarrow MgCl_2$

Valency 2 1

Here, the valency of magnesium is 2 and that of Cl is 1.

(3) $2Al + 3Cl_2 \longrightarrow 2AlCl_3$

Valency 3 1

Here, the valency of aluminium is 3 and that of Cl is 1.

Remember : The valency of element M is 2.

The valency of element N is 3.

Then, the molecular formula will be

Symbol of Elements M N Molecular Formula

Valency of Elements 2 3 M_3N_2

- The valency of carbon is 4 and that of oxygen is 2. Write the molecular formula of carbon dioxide.
- From the formula of water, H_2O, work out the valencies of hydrogen and oxygen.

Reviewing the Lesson

- Electrons, protons and neutrons are the fundamental particles in an atom.
- The protons and neutrons are in the nucleus of an atom. Electrons revolve around the nucleus of the atom.
- Protons have a positive charge, electrons have a negative charge while neutrons have no charge at all.
- The atomic number (Z) gives the number of protons in an atom which is the same as the number of electrons in it.
- The atomic mass number (A) is the sum of the number of protons and neutrons.
- Different isotopes of an element have the same atomic number but different atomic mass numbers.
- The capacity of an element to combine with another element is called its valency.

Exercises

1. **Answer the following questions.**
   (a) What is the difference between the models of the atom proposed by Thomson and by Rutherford ?
   (b) What is the characteristic property of the element hydrogen ?
   (c) What is meant by valency ?
   (d) What is meant by atomic mass number ?
   (e) Name the fundamental particles in an atom.

2. Give reasons.

(a) In Rutherford's experiment, some alpha rays collide with the gold sheet and are turned back.

(b) During ion formation, an electric charge develops on the elements.

(c) Why does ionisation take place ?

(d) All the mass of an atom is concentrated in the nucleus.

3. Fill in the blanks.

(a) If the valency of carbon is 4 and that of hydrogen is 1 then the molecular formula of methane is ..... .

(b) There are two electrons in the outermost orbit of the magnesium atom. Hence, the valency of magnesium is ..... .

(c) $^{35}_{17}Cl$ and ..... are isotopes of chlorine.

(d) Isotopes of uranium are used as ..... in atomic reactors.

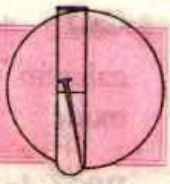
4. Match the following.

'A'	'B'
(a) Isotopes of cobalt	1. Three
(b) Valency of nitrogen	2. Treatment of cancer
(c) Non-metal	3. Electrons in the outermost orbit
(d) Metal	4. Receives electrons
(e) Valency	5. Loses electrons

Activity

- Find out about the scientific works of Dr Homi Bhabha.

6. Chemical Reactions and their Types



Many changes take place in our surroundings every day. Some of these changes happen quickly while some take place slowly. Iron articles left in the open begin to rust in some days. In summer, milk curdles in a few hours and rice batter ferments and becomes sour. Milk can be changed to yoghurt. Why do these changes occur ? It is because of chemical reactions taking place in them.

How are chemical reactions written ?

They are written in the form of equations. The substances taking part in a chemical reaction are called **reactants** and are written on the left hand side of the equation. The substances formed during the reaction are called **products** and are written on the right hand side. An arrow is shown between the reactants and products.

Types of chemical reactions

(1) Combination reactions

(2) Decomposition / Dissociation reactions

(3) Displacement reactions

Combination reactions

Try this : In a beaker, take some lumps of calcium oxide (quicklime) and add 50 ml of water to it. Feel the outside of the beaker. It will have become warm.

$$\underset{\text{calcium oxide}}{CaO} + \underset{\text{water}}{H_2O} \longrightarrow \underset{\text{calcium hydroxide}}{Ca(OH)_2} + \text{energy}$$

What do you understand from this equation ?

We see that the reaction between calcium oxide and water produces a single compound, calcium hydroxide.

Calcium oxide and water take part in the reaction. Hence, they are reactants.

Calcium hydroxide is formed as a result of this reaction. Hence, it is the product.

A chemical reaction in which a single compound is formed from two or more reactants is called a combination reaction.

Decomposition reactions

Reactions in which a substance is broken down and two or more substances are obtained from it are called decomposition reactions.

For example, when an electric current is passed through acidulated water, water dissociates into its constituent substances, hydrogen and oxygen. Thus, hydrogen and oxygen are the products of this reaction.

Displacement reactions

A reaction in which one constituent displaces another constituent and separates it is called a displacement reaction.

Try this

Take some pieces of zinc in a test-tube. Add dilute hydrochloric acid to the test-tube. You will see a gas coming out. In this reaction, zinc displaces hydrogen from hydrochloric acid.

$$\underset{\text{zinc}}{Zn} + \underset{\text{hydrochloric acid}}{2HCl} \longrightarrow \underset{\text{zinc chloride}}{ZnCl_2} + \underset{\text{hydrogen}}{H_2}$$

Oxidation and reduction

A chemical reaction in which oxygen combines with an element or a compound or a reaction in which hydrogen is lost from a compound is called an oxidation reaction.

$$\underset{\text{carbon}}{C} + \underset{\text{oxygen}}{O_2} \longrightarrow \underset{\text{carbon dioxide}}{CO_2}$$

A chemical reaction in which hydrogen combines with an element or compound or a reaction in which oxygen is lost from a compound is called a reduction reaction.

$$\underset{\text{chlorine}}{Cl_2} + \underset{\text{hydrogen}}{H_2} \xrightarrow{\text{heat}} \underset{\text{hydrochloric acid}}{2HCl}$$

The speed of chemical reactions

Rusting of iron is a slow reaction. But, when washing soda is mixed with lime juice, carbon dioxide bubbles out at once. The latter is a quick reaction. Various factors such as the size of the reactant particles, their temperature and concentration and the presence of catalysts can cause the

reaction to take place faster. Some reactions can be speeded up by catalysts.

A substance which does not take part in a chemical reaction but, by its presence, speeds up a chemical reaction, is called a catalyst.

Manganese dioxide acts as a catalyst in the preparation of oxygen from potassium chlorate.

When a vegetable oil is reduced, we get a hydrogenated oil. In this reaction, Raney nickel acts as a catalyst.

- Will the mass of the catalyst change during a chemical reaction ?
- Why do we use powdered sugar when making a sherbet ?

When some reactions take place, energy is given out while during others, energy is absorbed.

Try this : Take a 4 cm long magnesium ribbon. Hold one of its ends in a pair of tongs and light the other end. It will burn emitting a brilliant white light. Collect the white ash that remains.

Magnesium burns in air combining with the oxygen in it to form the white and powdery magnesium oxide.

$$2Mg + O_2 \longrightarrow 2MgO + \text{energy}$$

magnesium + oxygen → magnesium oxide + energy

What do you learn from the above reaction ? Energy is given out as magnesium burns in air.

A reaction during which heat is given out is called an exothermic reaction. Some reactions are such that heat is absorbed while they take place. Such reactions are called endothermic reactions.

Try this : Take some water in a test-tube. Feel the test-tube to get an idea of its temperature. Add some salt and stir the mixture. You get a solution of salt. Feel the temperature of the tube again. What do you see ? The temperature has fallen slightly. It means that this was an endothermic reaction.

You have learnt about the reaction between calcium oxide and water. What kind of reaction is that ?

- When carbon burns in air, carbon dioxide is formed. What type of reaction is that ?
- Is burning always an exothermic reaction ?
- Is the action of dissolving of a substance always an endothermic reaction ?

Besides energy exchanges, which other changes take place during a chemical reaction ?

When heat is supplied to a substance, its state changes, its temperature rises, its colour changes and it gives out gas. Observe these changes in the following activity.

Try this : Take three deflagrating spoons. Place some sulphur in one, coal in another and copper sulphate crystals in the third. Heat them.

What do you find ?

Carbon and sulphur burn when heated, that is, their temperature rises. Also, carbon dioxide and sulphur dioxide gases are produced. Their colour too, changes. The blue colour of copper sulphate changes on heating.

Reviewing the Lesson

- In a chemical reaction, 'products' are obtained from reactants.
- Symbols and formulae are used to write chemical reactions in the form of chemical equations.
- When writing chemical reactions, reactants are written on the left and products on the right.
- Chemical reactions are of various types, such as combination, decomposition, displacement, etc.

Exercises

1. Answer the following questions.

(a) Name the different types of chemical reactions.

(b) Explain the difference between a combination and dissociation reaction.

(c) Explain with examples what is meant by oxidation.

(d) Explain with examples what is meant by reduction.

(e) What is a catalyst ?

(f) On what factors does the speed of chemical reactions depend ?

2. Of which type is each of the following reactions ?

(a) $CaO + H_2O \rightarrow Ca(OH)_2 + \text{Heat}$

(b) $C + O_2 \rightarrow CO_2$

(c) $Cl_2 + H_2 \rightarrow 2HCl$

(d) $2Mg + O_2 \rightarrow 2MgO$

3. Write the equations for each of the following reactions and name the reactants and products of each.

(a) Coal was burnt in air.

(b) Magnesium wire was lit.

(c) Dilute hydrochloric acid was poured on to some zinc.

(d) Water was poured on calcium oxide.

4. Match the following.

'A'	'B'
(a) Reduction	1. Type of chemical reaction
(b) Oxidation	2. Combining with hydrogen
(c) Displacement	3. Speeding up a reaction
(d) Catalyst	4. Combination with oxygen

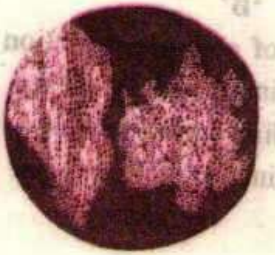
Activities

(1) Observe what happens when lemon juice falls on a Shahbad tile.

(2) Find out about the effects that perfumes have on jewellery / ornaments.

7. The Structure of a Cell and Micro-organisms

You have learnt that all living things are made of cells. Plants, animals, even our bodies are made of cells.



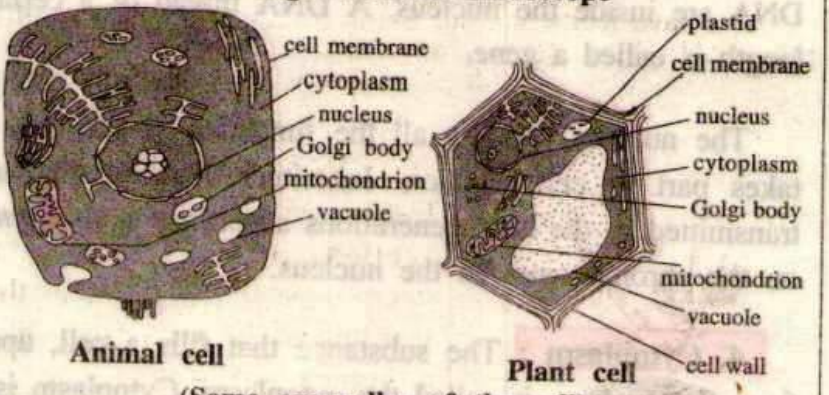
About 350 years ago, in the year 1665, Robert Hooke, an English scientist, observed a thin section of cork under a microscope. He found that the structure of the section was like a honeycomb – made up of many small compartments which he named 'cells'. The study of cells is called cytology.

Cells are studied with the help of a compound microscope. However, there are cells that cannot be seen even through the compound microscope. An electron microscope has to be used to study them. With the help of an electron microscope, it is possible to magnify infinitesimally small objects to view a large image. It magnifies objects 2 billion times, (2×10^9 times).

Living things can be seen to be made up of cells. A cell has a definite structure. Life processes of living things are carried out through these cells. To do this, the cell has various constituents. They are called organelles.

Organelles : The cell membrane, cell wall, cytoplasm, mitochondria, Golgi bodies, ribosomes, lysosomes, plastids, nucleus and vacuoles are the organelles of a cell.

Cells as seen through electron microscope



Animal cell **Plant cell**

(Some organelles of the cell)

Functions of some organelles

1. The cell membrane : The cell membrane is the outer covering of a cell. It is like a very thin, flexible layer.

The cell membrane protects the inner parts of the cell and regulates the flow of substances that enter into and pass out of the cell. The cell membrane maintains the shape of the cell.

2. The cell wall : The cell wall is found only in plant cells. The covering of the plant cell outside the cell membrane is called the cell wall. It is made of a substance called cellulose. Other substances can pass through it.

The cell wall gives the cell strength. Hence, the cell gets a definite shape and the inner components get protection.

3. Nucleus : The nucleus is the central and the largest component of the cell. It is usually round. The membrane around the nucleus is porous. Chromosomes made from DNA are inside the nucleus. A DNA thread of a certain length is called a gene.

The nucleus controls all the functions of the cell. It takes part in cell division. Inherited characteristics are transmitted to the next generations according to the genes on the chromosomes in the nucleus.

4. Cytoplasm : The substance that fills a cell, apart from the nucleus, is called the cytoplasm. Cytoplasm is a semi-fluid substance with water soluble organic and inorganic substances and the various organelles in it.

5. Mitochondria : These are of various shapes but they are mainly tubular. A mitochondrion has a double wall. The inner wall has folds.

Mitochondria produce energy from the food material in the cell and supply the energy to the cell when required. That is why they are called the powerhouses of the cell.

6. Golgi bodies : Golgi bodies are stacks of flat, membrane-bound sacs in the cytoplasm. They store enzymes.

7. Vacuole : A vacuole means an empty space. A vacuole is an organelle with a covering of a sing

membrane. Plant cells have large vacuoles. Vacuoles store products of excretion and secretions temporarily.

- How many chromosomes are there in the nucleus of the human cell ?
- Why is the euglena said to belong to both the animal as well as the plant kingdom ?

There are certain differences between the plant cell and the animal cell. They are as follows.

Animal cell	Plant cell
1. There is no covering around the cell membrane.	1. The cell wall surrounds the cell membrane.
2. Vacuoles are small.	2. Vacuoles are large.
3. There is no chlorophyll.	3. The cell has chlorophyll.

Micro-organisms : There are countless micro-organisms all around us in the air, water and soil. Some information about the different types of micro-organisms, such as viruses, bacteria, algae, fungii, yeast cells, protozoa, etc is given below. **Some micro-organisms are useful while some are harmful.**

Virus : It became possible to study viruses only because of the electron microscope. A virus has a simple structure without cytoplasm or organelles. The virus has a covering

of proteins. It contains de-oxyribonucleic acid (DNA) or ribonucleic acid (RNA). They cause various diseases in plants and animals.

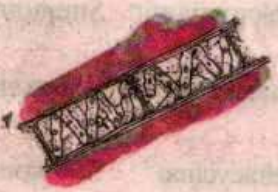
Bacteria : They are larger than viruses but cannot be seen without a microscope.

In bacteria, there are free chromosomes instead of the nucleus. They also have the organelles, a cell wall, cell membrane and cytoplasm. Some bacteria are beneficial, while some are harmful or disease producing bacteria. The rhizobium bacteria found in the nodules on the roots of leguminous plants are useful as nitrogen fixing agents. They transform nitrogen in the air to nitrogen compounds. These nitrogen compounds enter the soil and make the soil fertile. The azetobacter, a kind of bacteria in the soil, also fix nitrogen in the air independently. Soil contains several bacteria which decompose dead plants and animals and produce humus. This increases the fertility of the soil.

The staphyllococcus bacteria produce a poisonous substance called enterotoxin as it grows on foodstuffs. Eating these foodstuffs causes diarrhoea and vomiting. However, timely treatment cures the illness quite easily. Bacteria called clostridium are likely to grow in canned foodstuffs after their date of expiry. These bacteria produce toxic substances as they grow in foodstuffs. If such foodstuffs are eaten they cause diarrhoea and vomiting. That

is why, a can of foodstuffs carries an expiry date which tells us how long it is safe to consume the contents of the can. When we buy canned foods we must always check the expiry date.

Algae : Algae are found in wet, damp places. The cells of these plants which grow in water contain chlorophyll. They are autotrophic. Most algae are useful. Some kinds of algae serve as food. However, if they grow in overhead tanks of water where they get sunlight, the water gets a bad smell. Diatoms are a kind of unicellular algae.



Fungus : Some fungii are useful while some harmful fungii cause diseases of the skin or damage to substances. These plant cells do not contain chlorophyll. That is why, they are parasites. They grow in damp places on organic substances. In 1929, the scientist Alexander Flemming discovered that a substance produced during the growth of the fungus penicillium could kill certain micro-organisms. The well-known antibiotic penicillin is made from penicillium. Only certain micro-organisms are able to produce certain antibiotics. Also, an antibiotic can kill only specific micro-organisms. You can see this from the following table.

Antibiotic produced	Micro-organism producing the antibiotic	Germs destroyed
Penicillin	Penicillium chrysogenum	Diphtheria, Pneumonia germs
Chloromycetin	Streptomyces venezuelae	Typhoid germs
Streptomycin	Streptomyces griseus	Tuberculosis germs
Tetracycline	Streptomyces aureofaciens	Various germs
Erythromycin	Streptomyces erythreus	Various germs

Yeast cells : They belong to the class of fungii. Yeast cells cause fermentation. Fermentation caused by some micro-organisms results in the formation of organic substances with excellent taste and flavour. Bread, idlis, dosas are prepared by the process of fermentation. However, fermentation by some micro-organisms results in the formation of substances with unpalatable tastes and smells. These substances are not suitable as foods.

Protozoa : This is a class of unicellular animals. Their cells do not contain chlorophyll. They have a cell membrane and a nucleus. They grow by consuming ready food materials. Some protozoa are harmful. When protozoa like the amoeba enter our stomach through contaminated food or water, they cause illnesses like diarrhoea, vomiting, etc. If not treated in time, these disorders become chronic.

Reviewing the Lesson

- The cell is the basic constituent of every living thing. A compartment containing cytoplasm and enclosed in a cell membrane is called a cell.
- The main parts of a cell are the nucleus, cytoplasm and cell membrane. A plant cell has a cell wall made of cellulose, outside the cell membrane.
- The organelles namely, mitochondria, Golgi bodies, ribosomes, lysosomes, vacuoles are present in the cytoplasm. Cytoplasm contains both organic and inorganic substances.
- Some micro-organisms are useful while others are harmful.

Exercises

1. Answer the following questions.

(a) List the characteristics of the cell membrane.

(b) Explain the function of the nucleus.

(c) What function do vacuoles perform ?

2. Choose the right word to fill in the blanks.

(a) The ..... is an organelle found only in plant cells.

1. ribosomes 2. mitochondria 3. plastids 4. nucleus

(b) Chromosomes are found in the organelle call ..... .

1. plastids 2. mitochondria 3. nucleus 4. Golgi body

(c) The ..... cell carries out photosynthesis.

1. plant 2. yeast 3. muscle 4. nerve

3. Write notes on :

(a) mitochondria (b) antibiotics

(c) harmful bacteria (d) useful bacteria

4. Fill in the blanks.

(a) The name 'cell' was first used by the scientist ..... .

(b) The cell wall of the plant cell consists of the substance ..... .

(c) The cell wall is found only in the ..... cell.

(d) ..... is the powerhouse of the cell.

(e) The cell membrane is ..... .

5. Differentiate between :

(a) Plants cells and animal cells

(b) Cell membrane and cytoplasm

Activities

(1) Find out what skin donation is useful for.

(2) In order to observe protozoa like amoeba and paramoecium, collect the petals of some flowers. Place them in water for a day or two. Observe a drop of this water under a microscope.

(3) Peel off the thin membrane inside a layer of onion. Place it on a glass slide and put a drop of iodine on it. Cover it with a cover slip. Now your slide is ready. Observe it under a microscope. You will see cells which have a nucleus and are enclosed in a cell wall. Draw the onion cells as you see them under the microscope.

8. Diseases

A healthy society is a nation's resource. Hence, each one of us should take care of our health. You or your friends may have taken ill some time. Then the doctor must have prescribed medicines to cure the illness, and also told you what care you must take to prevent your condition from worsening.

Why does one get a disease ? There are micro-organisms around us. Some of them are useful but some can cause diseases. They can do us harm. They enter our body through food, water or air. If our resistance to disease is weak, we develop the symptoms of the disease. In other words we fall ill.

When a person gets a disease, his or her normal physical and mental condition and overall health are all disturbed.

Types of diseases : According to their mode of spreading, diseases can be classified into three types – 1. epidemic diseases 2. communicable diseases 3. contagious diseases.

1. Epidemic diseases : Certain changes in the weather, contamination of water, etc can cause many people to get the same disease simultaneously. Such a disease is called an epidemic disease. For example, cholera, typhoid, influenza (or 'flu'), diarrhoea, conjunctivitis, etc.

2. Communicable diseases : Constant sharing of space with a diseased person can result in the disease producing germs to enter a healthy person's body through the air.

Such diseases are called communicable diseases. For example, tuberculosis, influenza, etc.

3. Contagious diseases : Germs from the diseased person's body enter a healthy person's body through direct or close contact. These diseases are called contagious diseases. Examples are scabies and eczema, etc.

Diseases like those described above are caused by the micro-organisms bacteria and viruses.

In this lesson, we shall study the symptoms of various diseases and the measures for their prevention.

The symptoms of a disease are not seen as soon as germs enter a person's body. They appear after a certain period. The period between the entry of virus or bacteria and the appearance of symptoms is definite. It is called the incubation period. Each disease has a specific incubation period.

(1) Chickenpox

1. Mode of infection : A person gets chickenpox when the disease producing virus enters the body with the air that is breathed in, or by contact with an infected person, or by using the infected person's clothes, utensils, etc.

2. Main symptoms : (1) High fever
(2) Headache
(3) Small boils on the skin.
(4) They look like blisters. Scabs form on them in a few days.

3. Preventive measures and treatment : Proper medical treatment.

A person does not generally get chickenpox a second time. The resistance acquired the first time is lifelong.

- Which vaccine did Edward Jenner discover ? What prompted this discovery ?

(2) Polio

1. Mode of infection : The disease spreads through food, water or air contaminated with the polio virus.

2. Symptoms :

(1) Fever.
(2) Throat becomes red.
(3) Strain is felt in the muscles of the back and legs.
(4) Weakness in the muscles of the arms or legs.
(5) Growth of muscles is arrested.
(6) Muscles become flaccid and cause disability.

3. Preventive measures and treatment :
(1) Vaccination (2) Proper medical treatment.

Salk and Sabin were the scientists who succeeded in producing the polio vaccines using the polio virus.

The pulse polio campaign : The National Department of Health is at present running a campaign to administer the polio vaccine to the maximum possible number of children, under five years of age on the same day, all over the country, every year. This helps to strengthen the resistance of children of this age group to this disease. During this campaign every child in India under the age of five years is given two doses of this vaccine on two fixed days with an interval of 6 weeks

between them. These two doses are booster doses and have to be taken in addition to the regular ones.

This campaign is expected to eradicate polio from our country.

(3) Rabies

1. Mode of infection : The disease is caused by the bite of an affected dog, monkey, cat or rabbit.

2. Symptoms :

(1) Severe headache.
(2) Fever.
(3) Throat muscles become rigid and contracted. There is severe pain.
(4) Patient cannot swallow liquids or even water.
(5) Fear of water (hydrophobia).
(6) Patient is delirious.
(7) Patient's limbs become flaccid and go into a spasm. The disease can be fatal.

3. Preventive measures and treatment : (1) Clean the wound caused by the dog bite by flushing with soap and plenty of water. (2) Go to a doctor at once and take the required number of injections of the anti-rabies vaccine. (3) Give all pet animals in your house the anti-rabies vaccine.

Remember : People start treatment for this disease when they have been bitten by a dog, cat, monkey, etc. Sometimes, they do not take the prescribed number of injections out of fear or due to other reasons. Such incomplete inoculations may not prevent the disease.

(4) Tuberculosis (T.B.)

Robert Koch was the scientist who discovered the bacteria which cause this disease.

1. Mode of infection : The germs enter the air through the spittle of the patient. The disease spreads through the air.

2. Symptoms :

(1) Cough.
(2) Low grade fever.
(3) Blood in spittle.
(4) Loss of weight.
(5) Pain in the chest.
(6) Difficulty in breathing.

3. Preventive measures and treatment : (1) Taking the B.C.G. vaccination (2) Isolating the patient (3) Medical treatment.

At present, tuberculosis is considered to be a most easily communicable disease. In India, one T. B. patient dies every two minutes. The WHO (World Health Organization) runs a tuberculosis eradication campaign. DOT (Direct Observation and Treatment) centres have been set up for this purpose. Excellent medicines from the World Health Organization are available free of charge at these centres.

(5) Typhoid

1. Mode of infection : Through contaminated food and water as also through houseflies.

2. Symptoms :

(1) Fever that lasts for a definite period.

(2) Rose coloured rash on the chest.

(3) Diarrhoea.

(4) Headache.

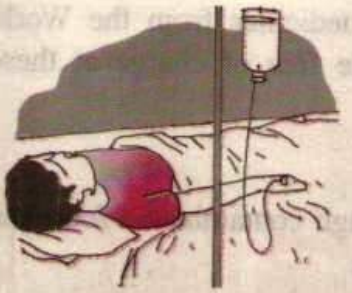
3. Preventive measures and treatment : (1) Taking the typhoid vaccine. (2) Drinking boiled water. (3) Not eating uncovered food especially when outside. (4) Eating only clean, fresh food. (5) Keeping food covered at home. (6) Maintaining public hygiene.

- What instructions are given by the Health Department during the rainy reason ?
- Why should we drink boiled water during the rainy season ?

(6) Cholera

1. Mode of infection : This disease spreads through water or food contaminated due to houseflies.

2. Symptoms :



(1) Severe diarrhoea and vomiting.

(2) Dehydration.

(3) Dry skin, sunken eyes.

(4) Stomachache.

(5) Cramps in the legs.

3. Preventive measures and treatment : (1) Maintaining hygiene in public places. (2) Controlling houseflies. (3) Not eating food left uncovered. (4) Drinking boiled water. (5) Taking the cholera vaccine.

The Health Department has made it obligatory to take the cholera vaccine before going to places of pilgrimage or travelling abroad. Human beings themselves are carriers of the 'vibrio cholerae' bacteria which cause this disease.

(7) Enteritis

The inflammation of the inner lining of the intestine due to infection by bacteria, virus, worms or by chemical or other harmful substances is called 'enteritis'. 'Enteron' means 'intestines' and '-itis' means inflammation.

1. Mode of infection : This disease spreads through contaminated food and water.

2. Symptoms : (1) Stomachache.

(2) Fever.
(3) Vomiting.
(4) Loss of appetite.
(5) Diarrhoea or constipation.
(6) Loss of weight.

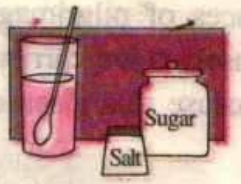
3. Preventive measures and treatment : (1) Consume only safe food and water. (2) Maintain personal cleanliness. (3) Keep food covered.

- What must be done to maintain personal cleanliness ?

(8) Diarrhoea

1. Mode of infection : Spreads through food via houseflies and also through contaminated water, milk.

2. Symptoms : (1) Dehydration due to loose motions.



(2) Sunken eyes.

(3) Dry mouth and lips.

(4) Reduced urine formation.

(5) Cold hands and feet.

(6) Slow pulse rate.

3. Preventive measures and treatment : (1) Drink boiled and cooled water. (2) Maintain personal cleanliness. (3) Prevent dust, flies from settling on food. (4) Maintain cleanliness in cooking area. (5) Wash fruits and vegetables before use.

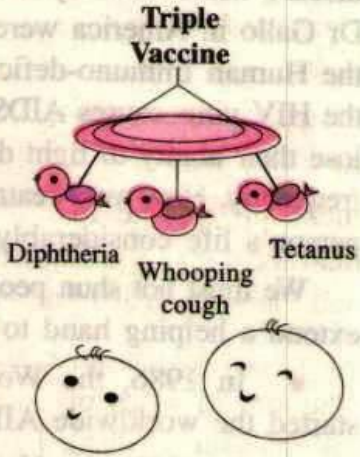
Dehydration : The body becomes dry because of loss of water due to diarrhoea. This is called dehydration. To make up for the loss of water due to loose motions or diarrhoea, give the patient Oral Rehydration Solution (ORS) and start medical treatment at once.

In Std V, you have learnt to prepare an oral rehydration solution. In cases of diarrhoea, the absorptive function of the intestine is disturbed. However, the sugar in the ORS can be absorbed in the body. Along with sugar, salt and water are also absorbed. This gives temporary relief. If medical treatment is given immediately, the possible serious consequences can be avoided.

Preventive measures and treatment : It is better to prevent diseases than to treat and cure diseases by medical treatment after they occur. Diseases can be prevented by vaccination.

Vaccines are available for the prevention of several diseases. Vaccinating a person strengthens his or her resistance to disease. Thus, vaccination is a preventive measure. Vaccinating people to prevent the danger of disease in future or to prevent an epidemic is the responsibility of the Health Department. Nevertheless, each one of us must also co-operate with the Health Department by taking care of ourselves.

The Government implements special programmes for the vaccination of children. Various types of vaccines such as the BCG, the triple vaccine (diphtheria, whooping cough, tetanus), polio, measles, double vaccine (diphtheria, tetanus), tetanus, hepatitis-B, etc are given to every child from time to time.



General measures for the prevention of disease

1. Drinking filtered and boiled water.
2. Taking a balanced diet.

3. Learning healthy habits.
4. Maintaining personal hygiene as well as keeping our surroundings clean.
5. Taking proper medical treatment immediately if symptoms of a disease are seen.

Remember : Diseases are caused by micro-organisms and not by the anger of gods or envy of others. They are cured with proper medical treatment, not with black magic or witchcraft.

- What will you do to keep the surroundings clean ?

(9) AIDS : AIDS is the acronym for Acquired Immuno-Deficiency Syndrome.

- In 1986, it became clear that the virus of this disease discovered by Dr Monteniere in France and also Dr Gallo in America were of the same kind. It was named the Human Immuno-deficiency Virus or HIV. Infection by the HIV virus causes AIDS. When someone gets AIDS, they lose their ability to fight disease. So, they contract diseases frequently. However, treatment can extend an AIDS affected person's life considerably.

We must not shun people with AIDS. In fact, we should extend a helping hand to them.

- In 1986, the World Health Organization (WHO) started the worldwide AIDS Control Programme.
- In 1987, the National AIDS Control Programme was started in India.

Through WHO, excellent medicines are available in government hospitals free of cost.

- Do we get AIDS by shaking hands with an AIDS affected person ?

Reviewing the Lesson

- Vaccinations help contain/prevent an epidemic.
- On the basis of their mode of spreading, diseases can be classified into three types – epidemic diseases, communicable diseases and contagious diseases.
- Many diseases can be prevented by ensuring personal and public cleanliness.
- The 'Pulse Polio' campaign has increased the possibility of eradicating polio.

Exercises

1. **Answer the following questions.**
   (a) What is meant by epidemic diseases ?
   (b) What is meant by communicable diseases ?
   (c) Why should a person suffering from tuberculosis avoid going to public places ?

2. **What are the symptoms of the following diseases ?**
   Polio, cholera, tuberculosis, typhoid.

3. **What measures can be taken to prevent the following diseases ?**
   Rabies, chickenpox, tuberculosis.

4. **Write notes on the following :**
   (a) Dehydration (b) Vaccination

5. What will you do ?

(a) A person having cholera is to be given temporary but immediate treatment.

(b) Your friend has contracted chickenpox.

(c) The diet of a person convalescing after typhoid is to be planned.

(d) A child in your class is an AIDS patient.

6. Give scientific reasons for :

(a) One should drink boiled water during epidemics.

(b) People suffering from communicable diseases should avoid going to public places.

(c) The wound caused by a dog bite should be flushed clean with soap and water.

7. Explain the importance of personal and public cleanliness.

Activities

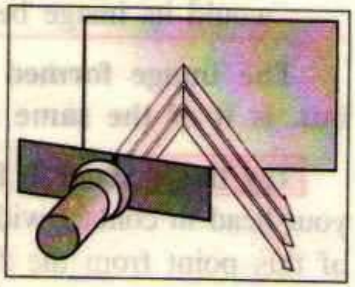
1. Write slogans for the polio eradication campaign.
2. Write slogans related to good health.
3. Visit organizations working for people affected by AIDS.
4. Read the biographies of any two scientists. Write about them in short and show your compositions to your teacher.
5. Obtain pictures of scientists and display them in your classroom.
6. Much information about AIDS is given in advertisements on radio and TV. Collect such information and make a scrapbook about the topic.

9. Reflection of Light

You know that, from any source of light, light is transmitted in straight lines. You have also learnt that if an opaque object is placed in the path of light, it casts a shadow on a screen.

Look at this picture alongside. Do you remember the story from the Panchatantra about the lion and the rabbit ? When the lion in the story looked down into the well, he saw another lion. It was the image of the lion formed in the water. How is an image formed ?

When rays of light fall on a surface they turn back. This is called the reflection of light. A rubber ball hitting a wall is turned back. That is reflection of the ball.



Try this : Take a simple electric torch. Stick a piece of paper having three slits over the glass of the torch. Spread a sheet of white paper on a drawing board. On one side of the board

place a flat or plane mirror upright. Now, place the torch on the board obliquely in front of the mirror, at a distance of about 45 cm from it. You will see three beams of light. Follow the path of the beams after reflection from the mirror. Thus, you can easily see how light is reflected.

Now, look into the mirror along the line of the reflected beams. You will see the bright slits of the torch in the mirror. Thus, you can see, that the beams are indeed the ones coming from the torch.

What happens when you look at yourself in the mirror ? Light rays starting from your face fall on the mirror, get reflected from it and enter your eyes. That is why you see your face in the mirror. It is your image formed in the mirror.

Try this : Place a lighted candle in front of a mirror. You will see a second candle in the mirror. We call the real candle 'the object' and the one in the mirror its 'image'.

- Why is the candle in the mirror not called an object ?
- If we were to hold the candle upside down, what would its image be like ?

The image formed in a plane mirror is upright, but, is it of the same height as the object ?

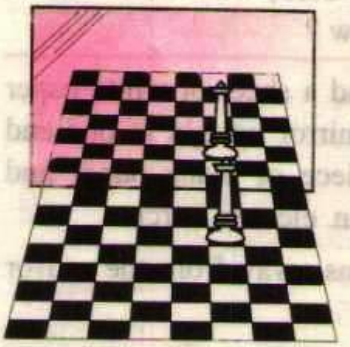
Try this : Stand in front of a full-length mirror. Place your head in contact with the mirror. Measure the distance of this point from the floor. What do you notice ?

The image formed in a plane mirror is upright and of the same size as the object.

- What will be the nature of a person's image in a plane mirror as compared to the person ?
- Why do we use a plane mirror while getting ready ?

You saw that the image formed in a plane mirror is behind the mirror but what is its exact location ?

Try this : Take a chessboard. Place only one piece – the queen – on it. Place a plane mirror upright at one end of the board. Now, place the queen in the middle of the third square from the mirror. Look at its image in the mirror. The image too is in the third square behind the mirror. Now, move the queen five squares further from the mirror. It is now at the end of the board. Where is its image now ? The image too is in the eighth square.



This shows that an image in a plane mirror is behind the mirror and at the same distance from it as the object.

Try this : Stand in front of a large mirror so that you can see your entire image in it. Make your friend stand next to the mirror, as shown in this picture.

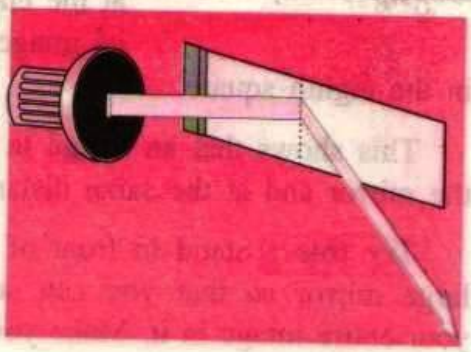
Look at the picture. Raise your

left hand. Tell your friend to look into the mirror and raise his hand in the same way as the image. He will raise his right hand. Now, raise your right hand. Your friend will raise his left. It means that the right and left sides are interchanged in the image formed in a plane mirror. This is called lateral inversion and such an image is said to be laterally inverted.

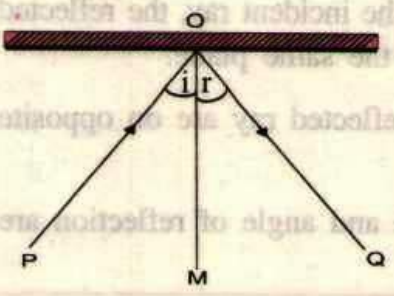
- Why is the word 'ambulance' written on an ambulance as AMBULANCE ?
- If the hands of a clock show 5.15, what time will its image in a plane mirror show ?

The laws of reflection : Spread a sheet of white paper on a drawing board. Fix a plane mirror upright at one end of the paper. Make a slit in a piece of black paper and stick the paper on the glass of an electric torch.

Now, place the torch 10-15 cms away from the mirror as shown. Make the room dark. Switch on the torch. What do you see ? A beam of light from the slit in the paper falls on the mirror at an angle to it. This beam of light is 'incident' on the mirror. This is shown by the 'incident ray' PO. Draw a line perpendicular to the mirror at the point of incidence of the ray. This line is called a 'normal'.



Now, looking at the ray of light reflected from the mirror draw it on the paper. This is our 'reflected ray'. Do this experiment four or five times, with different angles of incidence.



Look at the figure alongside. PO is the incident ray and OQ is the reflected ray. OM is the normal. The angle that the incident ray makes with the normal is called the angle of incidence.

$\angle POM = \angle i$ is the angle of incidence.

The angle made by the reflected ray with the normal is called the angle of reflection. $\angle QOM = \angle r$ is the angle of reflection.

Now, from the observations you made four or five times, note the value of corresponding angles of incidence and reflection in the table below.

No.	Angle of incidence $\angle i$	Angle of reflection $\angle r$
1.		
2.		
3.		
4.		
5.		

What do you notice ? In each observation, $\angle i$ and $\angle r$ are equal. From the diagram, you will also notice that the two rays and the normal are in the same plane. From this experiment, we can infer the laws of reflection.

Laws of Reflection : (1) The incident ray, the reflected ray and the normal are all in the same plane.

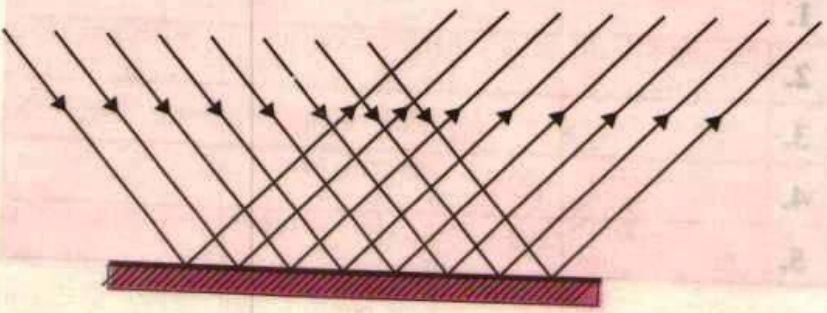
(2) The incident ray and reflected ray are on opposite sides of the normal.

(3) The angle of incidence and angle of reflection are of equal measure.

- How should a ray of light be incident on a mirror placed at right angle to the floor, in order that the reflected ray comes downwards ? Which plane will contain these two rays and the normal ?

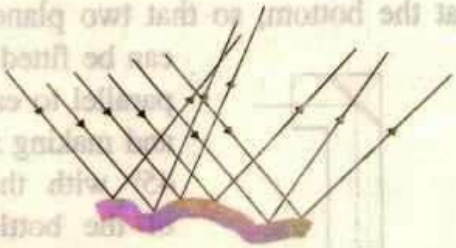
Types of reflection : Light is reflected from smooth as well as rough surfaces. Reflection from a smooth surface is called regular reflection.

The diagram below shows how light is reflected from a smooth surface like that of a plane mirror. What inference can you draw from it ?



When parallel rays fall on a smooth surface their angles of incidence are all equal. The angles of reflection too are equal. They are also equal to the angle of incidence. Such reflection is called regular reflection.

On the other hand, when parallel incident rays fall on a rough surface the reflected rays do not remain parallel to each other, but get scattered over a wider surface.



Such reflection is called irregular reflection.

- Are the laws of reflection followed when irregular reflection takes place ?
- Why do rays in a parallel beam of incident light not remain parallel to each other after reflection from a rough surface ?

Reflection of reflected light : At night you can see the image of the moon in a mirror. Which is this light that reaches your eyes ?

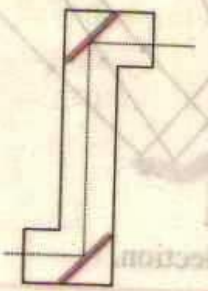
The sun's light falls on the moon and is reflected from it. It is reflected a second time from the mirror. In this way, light can be reflected several times.

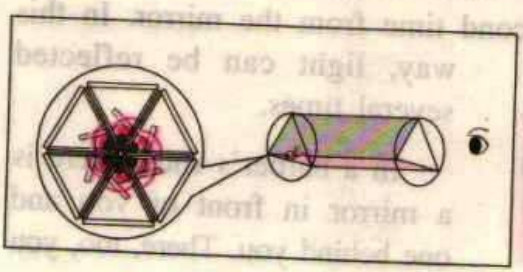
In a barber's shop, there is a mirror in front of you and one behind you. There, too, you

can see reflection taking place more than once. In fact, we get an infinite number of images in such parallel mirrors.

A periscope

Try this : Take a plastic bottle. As shown in the figure make two oblique cuts in it in two places, at the top and at the bottom, so that two plane mirrors can be fitted in them, parallel to each other and making angles of 45^0 with the length of the bottle. Make one-inch windows in the bottle in front of the two mirrors. Now, look in through the lower window. You will see the image of objects that are in front of the upper mirror. How does this happen ? First the image is formed in the upper mirror. It gets reflected into the lower mirror and can be seen through the window at the bottom. This instrument is called a periscope. A periscope is useful on a submarine for keeping a watch on things above even while the submarine is below the surface of the sea.





Try this : Take a long, cylindrical case. Fit three mirrors inside it, making angles of 60^0 with each other.

Cut off the base of the cylinder and cover it with white kite paper. Put four or five pieces of coloured glass into the case. Make a small hole in the lid of the box.

Put your eye near the hole and turn the box towards the light. You will see a number of colourful images. Turn the box a little and you will see different colourful patterns.

What makes this happen ? Three mirrors reflect the objects several times and we see several images. That is also the reason why we see these many patterns.

Nowadays, we see lines of specific colours painted along the sides of a road. The paint used is fluorescent paint. When light falls on it, it shines. The lines are easily seen in reflected light and serve to guide drivers of vehicles, when it is dark.

- Why is the surface of a glass made shiny when making a mirror ?

Reviewing the Lesson

- Light rays falling on a surface get reflected from it.
- The incident ray, normal and reflected ray are all in the same plane.
- The angle of incidence and the angle of reflection are of equal measures.
- Reflection is of two types – regular and irregular.

Exercises

1. Answer the following questions.

(a) How many times is an image in a plane mirror bigger or smaller than the object ?

(b) Where is the image formed in a plane mirror located ?

(c) Explain the difference between regular and irregular reflection.

(d) How many images are obtained in two parallel mirrors ?

(e) Why are the two mirrors in a periscope placed parallel to each other ?

2. Give reasons.

(a) Letters appear laterally inverted in a plane mirror.

(b) Numerous images are seen in the 'Palace of Mirrors'.

(c) The image formed in water is of the same size as the object.

3. Match the following.

'A'	'B'
(a) Image in a plane mirror	1. Fluorescent paint
(b) Regular reflection	2. Smooth surface
(c) Angle of incidence = 30^0	3. As big as the object
(d) A shiny image	4. Angle of reflection = 30^0
	5. Periscope

4. Fill in the blanks.

(a) The incident ray, the normal and the reflected ray are all in the same ..... .

(b) Reflection from a rough surface is called ..... reflection.

(c) In a periscope, we see ..... reflection of an object.

(d) In a plane mirror, the image is ..... inverted.

Activity

- Place two mirrors parallel to each other and count the number of images formed in them.

10. Sources of Energy

We start the day by boiling milk which requires heat energy. Electric energy is needed for the lamps. **Whatever the form of energy, it can do work.** When we switch on an electric lamp, electrical energy is converted into light energy. In a microphone, electric energy is converted into sound energy. Thus, **although energy has many forms, it can be changed from one form into another.**

How did man first produce heat energy ? When man lived in caves and began to hunt, he would make a fire to roast the animal he had hunted. He used the firewood he found in his surroundings for this purpose and thus man began to make use of heat energy. A substance that produces energy on burning is called a 'fuel'.

Fossil fuel : A long time ago, remnants of plants and animals got buried into the earth. Due to the effect of the tremendous pressure of the layers of earth above and the heat inside they were converted into fuels. Such fuels are called fossil fuels. It takes lakhs of years for such fuels to be formed. That is why the stores of fossil fuel are limited. As a result, a need is now felt to make prudent use of these resources.

Fossil fuels are found in three forms – solid, liquid as well as gaseous – in the bowels of the earth. These

fuels include coal, mineral oil and natural gas. Scientists believe that of these, coal was made from the remains of plants, and mineral oil and natural gas were formed from marine plants and animals. All fossil fuels contain hydrocarbon compounds.

Besides these, we daily use other fuels, too, for example, wood, charcoal, cowdung pats, etc.

Firewood and brushwood are used as fuel in rural areas. One kilogram wood gives about 1700 kilojoules of energy. Joule is a unit of energy. The energy obtained from wood is far less than the energy obtained from coal. It is a matter of concern that the use of wood for fuel is causing the destruction of forests and has endangered the environment. Charcoal is formed when wood is burnt in insufficient air. Charcoal burns smokelessly.

Mineral oil is found nearly 25,000 metres deep in the bowels of the earth. Petrol, diesel, kerosene and fuel oil can be obtained from it. Petrol is used as fuel in motor vehicles, kerosene is a household fuel whereas fuel oil is used in big furnaces in factories.

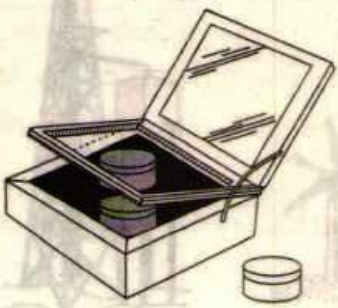
Natural gas is a very convenient fuel to use. It lights up quickly and burns without leaving behind any solid substances. Besides, it is easy to transport from its main source by means of pipes over long distances. A big advantage is that the burning of natural gas can be easily controlled.

Methane (CH_4), ethane (C_2H_6), propane (C_3H_8), butane(C_4H_{10}), etc are the various types of natural gas.

The deposits of fossils and other fuels are limited. How do you think these fuels were formed in the first place ?

The sun is the one and only source of energy in our solar system. The energy from the sun is absorbed by animals and plants. They are nourished by the sun's energy. Solar energy gets stored in their bodies in the form of chemical energy. After they die, this same energy becomes available to us in the form of fossil and other fuels. Such is the energy cycle on earth.

The earth gets a tremendous amount of energy from the sun – as much as 7×10^{17} kilowatts per year. You could hardly imagine that all the energy we need every year is given to us by the sun in just 40 minutes, and that too, entirely free of cost, neither metered nor monitored. The only question is how to harness it and how to use it !

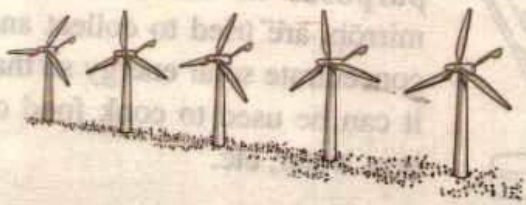


Now, solar heaters and solar cookers are available for this purpose. In these devices, mirrors are used to collect and concentrate solar energy so that it can be used to cook food or heat water, etc.

The solar cell : In the solar cell, solar energy is converted into electric energy and this can be used at night for lighting. The use of solar lanterns, which are now available in the market, is also on the rise.

- Which energy is stored in cattle dung ?
- Why is solar energy more important in India ?
- What happens to the solar energy absorbed in water ?

What is the difference between fossil fuels and solar energy ? There are only limited deposits of fossil fuels. Coal, mineral oil, etc are said to be conventional or non-renewable sources of energy – they cannot be produced anew. Solar energy is called a non-conventional or renewable source of energy because it is always available. Which other source of energy do you think is renewable ?



Even though we are now using renewable sources of energy like wind energy, hydro-electric energy, biogas, biodiesel, etc, we are still in the grip of an energy crisis. The main reason for this is the growing population and increasing industrialisation. It is difficult to continuously produce the increasing amounts of energy they need. To find ways of using renewable sources is the need of the hour.

Although it is convenient to use conventional energy sources like mineral oil and coal, they have given rise to several problems.

The carbon dioxide emitted by the burning of conventional fuels is causing a rise in global atmospheric temperature.

Many other gases have added to the gravity of the problem of pollution. Gases released in the atmosphere have given rise to dangers like acid rain.

The holes in the ozone layer of the atmosphere are allowing the passage of harmful rays to the earth.

Unrestricted cutting down of trees has caused degradation of forests. The diversity in plant life is threatened. Since these are the circumstances, the government is encouraging the increasing use of renewable energy sources. Besides, we are compelled to import 70 percent of the mineral oil we

use. In view of this, for installing solar energy, wind energy and biogas plants, the government has started substantial programmes making available financial subsidies and other facilities like the technology.

Atomic energy : Atomic energy is obtained when uranium atoms are bombarded with neutrons. This has been put to use in India in our atomic energy projects. The atomic power plant at Tarapur in Maharashtra generates electricity. There is also another project at Kakrapar in Surat district. The government plans to start several more such projects. Thus, we shall be able to harness this altogether different source of energy. It offers some hope of alleviating the energy crisis.

India's rate of development is steadily increasing. It is being recognized by other countries of the world as the leading developing country. Economists predict that by year 2020 India will be a major power in the world. India has, therefore, resolved to meet the energy crisis in order to maintain the present rate of growth. For this, the government is focusing on the following points.

(1) Finding out new sources of energy.

(2) Giving preference to renewable sources of energy.

(3) Using non-renewable sources of energy responsibly and sparingly. Educating the public about these issues.

(4) Promoting the use of devices that consume less fuel, such as stoves, burners, lights that make use of new technology.

- Why do renewable sources of energy not cause pollution ?
- With whom does the ownership of renewable sources of energy rest ?

Reviewing the Lesson

- Those substances that give out energy when they burn are called fuels.
- Coal, mineral oil and natural gas are fossil fuels.
- Deposits of fossil fuels are limited.
- The rising demand for energy is the cause of the energy crisis. It is imperative to harness non-conventional or renewable sources of energy to resolve this crisis.

Exercises

1. Answer the following questions.

(a) What is meant by 'fuel' ?

(b) Name the different types of fossil fuels.

(c) Which are the renewable sources of energy ?

(d) Which element is used for the production of atomic power ?

2. Give scientific reasons.

(a) Deposits of fossil fuels are limited.

(b) Solar energy is the source of all forms of fuels.

(c) Natural gas is convenient to use as a fuel.

(d) The temperature of the atmosphere is rising.

3. Fill in the blanks.

(a) Charcoal is produced by burning wood in ..... air.

(b) All fossil fuels contain ..... compounds.

(c) ..... and ..... are renewable sources of energy.

(d) In Maharashtra there is an atomic power project at ..... .

4. Match the following.

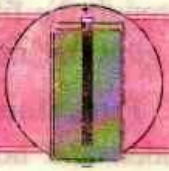
'A'	'B'
(a) Mineral oil	1. Buried plants and animals
(b) Atomic energy	2. Renewable energy sources
(c) Wind energy	3. Uranium
(d) Fossil fuel	4. Petrol

Activities

(1) Obtain the leaves and fruits of the jatropha trees that grow in the open countryside. Find out the uses of this plant and write a note about it.

(2) Find out about the structure and function of the biogas plant.

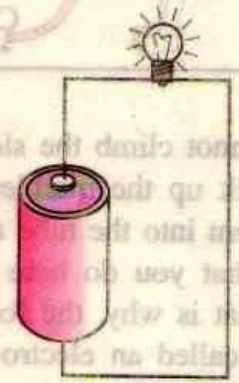
11. Electric Current



You have learnt that when silk is rubbed on glass, the glass develops positive electric charge and the silk, negative charge. These charges remain still on those bodies and are therefore called static electric charge.

What will happen if these charges are made to move by applying force ? A flow or current of charges will be created. When water flows down a slope, we call it a current of water. Similarly, a flow of electric charges is called an electric current.

Try this : Take a dry cell, like the one used in an electric torch. It has two ends or poles – the positive and the negative pole. As shown in the figure, connect the ends of two short copper wires one to each of the poles. (Now-a-days, a readymade case is available for this purpose.) Connect the other end of each wire to an electric bulb. What do you see ? The bulb lights up as soon as the wires are connected. Why does the bulb give out light ?



The electro-chemical cell in the circuit moves the stationary negative charges in the wires by applying force to them. The electric current generated in this way passes

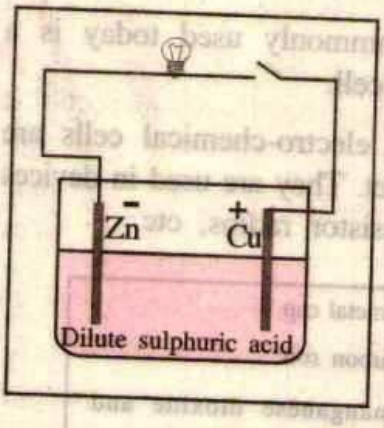
through the filament (the fine wire) of the bulb and makes it glow by raising its temperature.

Functions of the electro-chemical cell : To understand how exactly an electric cell works, carry out the following activity.

Try this : Take a narrow plastic tube ABC and hold it as shown in the figure alongside. Take some marbles and drop them one by one into the tube from the end A. The marbles quickly roll down the tube and emerge from the other end C. Thus, ABC can be said to become a current of marbles. However, the marbles cannot climb the slope from C to A. Now, if you were to pick up the marbles at C, take them to A and then drop them into the tube again, this current could go on flowing. What you do here is exactly what the electric cell does. That is why, the force applied by an electro-chemical cell is called an electro-motive force, that is, a force that sets electric charge in motion.

Electrons in motion give rise to an electric current. We have seen that the electro-motive force necessary to move electrons is provided by means of electric cells. These cells are of different types. The dry cell used in an electric torch is one of these types of cells.

The simple cell : The figure alongside shows how a simple electric cell is connected in an electrical circuit. A plate of zinc (Zn) and another of copper (Cu) are made to stand some distance apart in a glass trough. The trough is filled with dilute sulphuric acid. The Zn plate acts as the negative (-) pole and the copper plate as the positive (+) pole of the cell. It means that the electric current flows from the positive (copper) pole to the negative (zinc) pole. The circuit includes a bulb and a key which can be opened or closed. The electric current can be started or stopped whenever desired by closing or opening the key. This cell is called a Volta's cell. The electric current it generates is a result of the chemical reaction that takes place in the cell.



- When an electric current flows, what is the direction of motion of electrons ?
- What is the advantage of having a key in the circuit ?

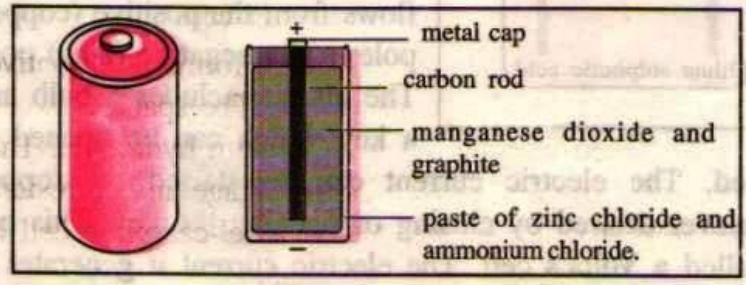
The Leclanche cell : After the simple Volta's cell, the next cell that was made in 1866 by a French scientist Georges Leclanche, was named the Leclanche cell.

In a cylindrical porous pot, there is a mixture of manganese dioxide and carbon. A carbon rod placed in this pot acts as the positive pole, and a zinc rod, is the negative pole. A solution of ammonium chloride is filled in a large

glass container and the porous pot and the zinc rod ar placed in it. The chemical reaction between manganes dioxide, zinc and ammonium chloride causes an electri current to flow.

The dry cell that is so commonly used today is modification of the Leclanche cell.

The dry cell : Small, dry electro-chemical cells ar now easily available in the market. They are used in device like electric toys, torches, transistor radios, etc.



Obtain a used up dry cell. Remove its outer coverin You will see a whitish cover inside. This outer covering c the cell is made of zinc (Zn) and acts as the negative (- pole of the cell.

Break open this covering. Now you will see a carbo rod. This is the positive (+) pole of the cell. Around it i a mixture of finely powdered manganese dioxide (MnO and graphite (C) held in a bag of thin material. The spac between this bag and the outer cylindrical zinc cover i filled with a moist paste of zinc chloride ($ZnCl_2$) an ammonium chloride (NH_4Cl). Then, the carbon rod is fitte with a metal cap and the cell is sealed.

The chemical reaction taking place in this kind of cell and giving rise to the current, is very slow. Hence, the reaction carries on for a long period of time. That is why, the dry cell has a longer life than other cells.

- Why was the 'dry cell' given this name ?
- What is the direction of the electron current in a dry cell ?

The nickel-cadmium cell : Portable machines that run on electricity, like the drilling machine or some gardening tools, make use of the nickel-cadmium cell.

In this cell, the metal cadmium (Cd) forms the negative pole and nickel (Ni), the positive pole. The space between the poles is filled with the alkali potassium hydroxide. The cell is made air-tight to prevent both leakage and corrosion. Another important advantage of the nickel-cadmium cell is that it can be recharged again and again.

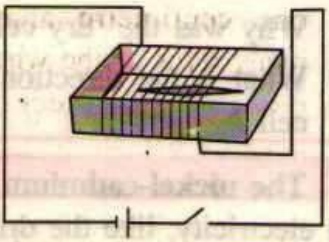
The button cell : As the name says, this cell is button-shaped. These days, electric cells are used in many devices like watches, toys, cameras, calculators, etc. Because of limits of space, the cell needs to be as small as possible. Watches especially make use of button cells. This cell is also called a lithium cell. It has a negative pole of lithium iron phosphate and a positive pole of carbon. The space between them is filled with a lithium salt.

Not only is the lithium cell easy to use, but there is also no possibility of damage to the other delicate parts of the gadget as this cell does not leak.

However, the lithium cell cannot be recharged. It simply has to be replaced with a new cell.

The magnetic field of an electric current

Try this : Take an empty matchbox tray. Place a freely turning magnetic needle in it. Wind three or four turns of a copper wire around the tray. Connect the two ends of the wire to the poles of a dry electric cell. As shown in the diagram, insert a key in the circuit. Keep the key open. Observe the magnetic needle. It rests in the north-south direction. Bring a bar magnet near the needle. You will see its deflection clearly. Remove the magnet. The needle will go back to rest in the north-south position. Now, close the key. This will at once cause an electric current to flow through the turns of wire around the matchbox. Look at the needle. What do you see ?



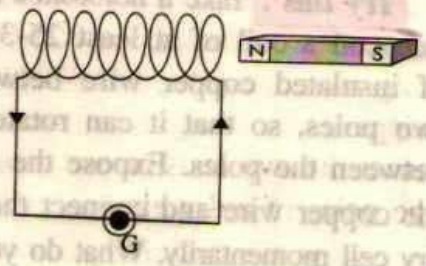
As soon as the electric current begins to flow, the needle gets deflected. When the circuit is open, the current stops and there is no deflection.

What can you infer from this experiment ?

While an electric current flows through a conductor, it behaves like a magnet. Hence, a magnetic field develops around it, which causes the deflection of the needle.

Electro-magnetic induction : If there is a change in the magnetic field associated with a coil of wire, electric current begins to flow through the coil. Such a current is called an induced current. This phenomenon of the change in a magnetic field and the electric current that it generates is called electro-magnetic induction.

Try this : Take a coil of insulated copper wire. The coil should be closely wound with a diameter of one centimetre and as many turns of the wire as possible. Connect the ends of the wire to a galvanometer G. The deflection of the needle in the galvanometer can tell us both the direction and strength of the current.



Bring the north pole of a bar magnet swiftly near the coil. You will see deflection in G. Again, swiftly draw the north pole away from the coil. You will see a deflection again but it will be in the opposite direction. Thus, you can infer that :

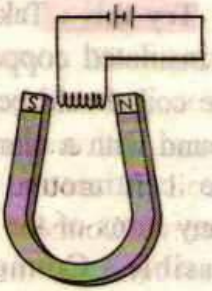
1. An electric current flows through the coil so long as the magnet is moving. 2. The direction of the current depends upon the direction of movement of the magnet, that is, the direction of the current as the magnet moves towards the coil is opposite to the direction of the current generated as the magnet moves away.

- What difference will you see in the electric current if the magnet approaches the coil with greater speed ?
- Will there be an induced electric current if the magnet remains at rest ?

Thus, due to the relative movement between a magnet and a conductor, there is electro-magnetic induction, and an electric current starts flowing through the conductor.

The credit for this basic experiment related to electro-magnetic induction goes to Michael Faraday.

Try this : Take a horseshoe magnet. Suspend a coil of at least 25-30 turns of insulated copper wire between its two poles, so that it can rotate freely between the poles. Expose the ends of the copper wire and connect them to a dry cell momentarily. What do you see ?



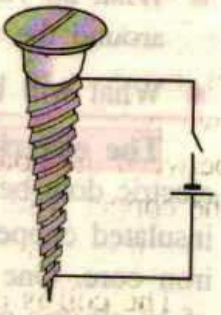
The coil is deflected. What causes the deflection ? We have seen that when an electric current flows through a coil, the coil behaves like a magnet. One of its sides develops the north pole and the other, the south pole. If the north pole of the coil happens to be towards the north pole of the horseshoe magnet, there will be repulsion between them. The suspended coil will be deflected and will therefore rotate.

This eventually led to the invention of the electric motor. The armature in the motor is the coil of wire in the above experiment. The direction of the current flowing through it must be changed after every half rotation. Otherwise, when the north pole of the coil comes near the south pole of the magnet, there will be attraction between them and the coil will stop rotating. A commutator helps to change the direction of the current in the coil after every half rotation.

Thus, the principle of setting an armature in motion by sending an electric current through it is used in the electric motor.

Electro-magnet : We have seen that when a current is passed through a conductor, it can work like magnet. We can easily make such a magnet. It is called an electro-magnet.

Try this : Take a 40-50 cm length of insulated copper wire. You can easily get such a wire from an electrical goods shop. Coil it around an iron nail or screw. Connect its ends to a dry cell and include a key in the circuit. Spread some thin iron pins under the nail. Close the key. What do you see ?



The moment you close the key, the nail attracts the pins towards itself. When you open the key, the pins fall off. Why does this happen ?

When the electric current flows through the coil around the wire, the nail gets magnetic properties. Hence, it attracts the pins. On opening the key, the current stops and the magnetic effect of the nail disappears.

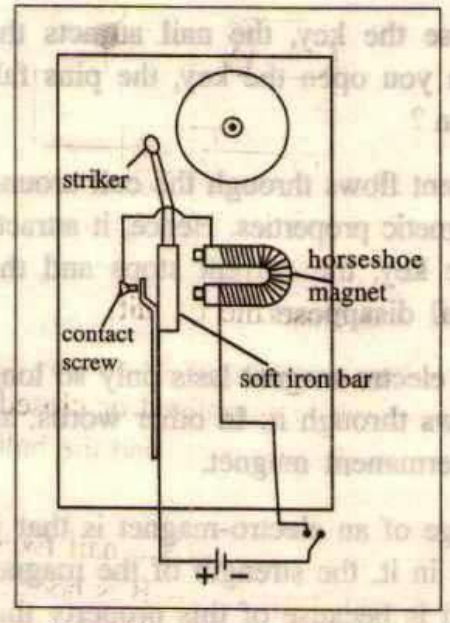
The magnetism of the electro-magnet lasts only so long as the electric current flows through it. In other words, an electro-magnet is not a permanent magnet.

An important advantage of an electro-magnet is that if stronger currents are used in it, the strength of the magnet also goes on increasing. It is because of this property that electro-magnets are used in big cranes for moving heavy loads.

Nowadays we get many toys that run on electric cells. The movement in the toys is also caused by the electro-magnets.

- What do you think will happen if the number of turns around the nail are increased ?
- What will be the effect of using a thicker wire ?

The electric door-bell : We are all familiar with the electric door-bell. Actually, you can make one yourself. An insulated copper wire is coiled around a horseshoe-shaped iron core. One end of the wire is connected to one pole of an electric cell. When the electric current flows through the coil, the core behaves like a magnet. A flexible iron strip is placed in front of this magnet. A metal striker is attached to this strip. It can strike a metal gong. The strip is in contact with a contact screw as shown in the figure. The other pole of the cell is connected to this contact screw through a switch.



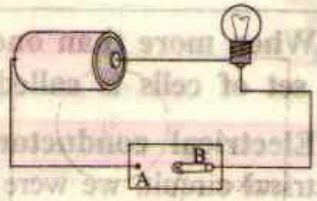
When we press the switch, the circuit gets completed and an electric current flows through the coil making the core an electro-magnet. At once, it attracts the flexible iron strip. The striker then hits the gong and a sound is produced. However, in this position, the contact of the strip with the screw breaks and the current stops. The coil is no more a magnet. So, the flexible strip moves back and makes contact with the screw. This causes the

current to flow again and the striker again hits the gong. This make and break arrangement keeps the bell ringing till the switch is pressed.

- What is the use of the flexible strip ?
- What will happen if the strip loses its flexibility ?

The electric circuit : When an electrical gadget is connected to an electric cell, an electrical circuit gets completed. However, certain components are necessary for completing a circuit.

Look at the figure alongside carefully. How many parts do you see in it ?



1. The electric cell
2. The electric bulb – an electric gadget.
3. Conducting wires.
4. A key that can open and close the circuit.

There must be at least the above components in a circuit. When the key is closed, the circuit is completed or closed. The current flows through the conducting wires and the bulb lights up.

In the figure above, B is a safety pin, A is a nail fixed firmly in a wooden board. When the safety pin B is hooked into the nail A, the circuit is complete and the current starts flowing.

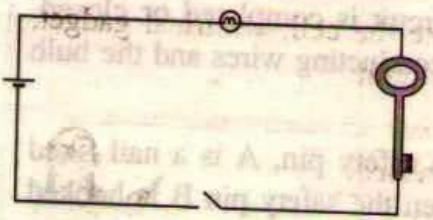
- What is the function of the switches in our homes ?
- What will happen if there is no key in a circuit ?

When drawing a circuit diagram, it is convenient to use certain symbols. Some of these are given below.

Components of the circuit	Symbol
1. Electric cell	
2. Bulb	
3. Key	
4. Wire	

When more than one cell is connected in a circuit, the set of cells is called a battery of cells.

Electrical conductors and insulators : If, in an electrical circuit, we were to use a cotton yarn in place of copper wires, will the gadget in the circuit work ? Substances through which electricity can flow are called electrical conductors. The metals copper, iron, aluminium, etc are excellent conductors of electricity.



Which parts do you see in the figure ? Besides the bulb, cell and key, another large metal key is connected in the circuit. Metals are conductors. They help to complete the circuit and allow the electrical gadget to work. That is why the bulb lights up. On the contrary, rubber, wood, cloth are insulators. An electric current does not flow through them.

- What is an insulation tape made from ?
- Name the components of the electrical circuit in the diagram below.

Reviewing the Lesson

- Electro-motive force is applied by means of electric cells. This causes an electric current to flow through a circuit.
- Cells are of various types namely, dry cells, Volta's cells and Leclanche cells.
- An electric door-bell can be made using an electro-magnet.
- There are components like the cell, electrical gadget, key, etc in an electric circuit.

Exercises

1. Answer the following questions.

(a) Why is the direction of the current in an electric motor reversed after every half round ?

(b) How can the strength of an electro-magnet be increased ?

(c) What is the principle of the electric motor ?

(d) Why is there a key in an electrical circuit ?

(e) Is the mechanism of a shirt button like that of the key in an electric circuit ?

2. Give scientific reasons.

(a) The copper wire used in an electro-magnet is insulated.

(b) In an electric bell, the electric current stops again and again.

(c) Electrical switches are made of plastic.

3. Match the following.

'A'	'B'
(a) Carbon, zinc	1. Armature
(b) Copper, zinc	2. Insulator
(c) Electric motor	3. Dry cell
(d) Protection from electric current	4. Simple cell

4. Draw a circuit diagram using the symbols for an electric cell, key, electric bulb and conducting wires.

Activity

- Find out how the tubelights on a vendor's cart work.

12. Properties of Substances

You know that solid, liquid and gas are the three states of matter. You have also learnt that at normal temperature, copper is in the solid state while oxygen is in the gaseous state. The state of a substance depends upon the energy it contains. If there is a change in this energy, that is, if the substance is heated or cooled, its state changes. If a solid substance is heated, it changes into a liquid.

Try this : Take a candle. Light it and observe the changes of state that take place. Wax is a familiar example that shows change of state.

A liquid changes into a gas during vaporization, a liquid changes into a solid during freezing and a gas changes into a liquid during condensation. These are the ways in which changes of state of matter take place.

You have seen ice melting and water boiling but to know exactly at what temperature melting or boiling takes place, we must understand melting points and boiling points. Every substance has a specific melting point and boiling point.

The temperature at which the state of a substance changes from solid to liquid is called the melting point of the substance. The melting point of ice is 0^0C while that of iron is 1535^0C.

The temperature at which a liquid boils is called the boiling point of the substance. The boiling point of water is 100°C while that of iron is 2750°C.

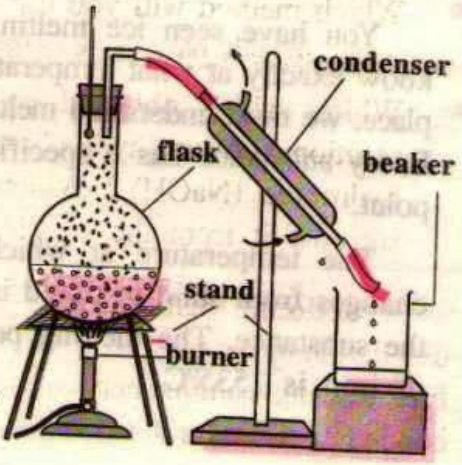
During evaporation, too, a liquid changes into a gas. However, evaporation may take place at any temperature and only takes place on the surface of a liquid. You must have observed that after a shower of rain, the water on a road evaporates after some time. Wind and higher temperature speed up the process of evaporation.

- In which state is the LPG in the cylinder of the cooking stove ?
- What is the characteristic of naphthalene balls?

Distillation : Distillation is the process in which a liquid is first heated up to its boiling point and then, its vapour is cooled to obtain the liquid again.

- How is drinking water obtained from sea water ?

Try this : Take a solution of some common salt in water in a round bottomed flask. Set up the apparatus as shown in the figure. Fit the flask with a two-holed rubber stopper. Fit a thermometer in one hole. In the other, fit a bent glass tube.



Connect the outer end of the bent tube to a condenser by means of a rubber tube. Fit another piece of rubber tube to the lower end of the condenser and put its end into a beaker.

What is a condenser ? It consists of a glass tube placed inside another glass tube of a bigger diameter. The wide outer tube has an inlet and an outlet to allow the circulation of cold water around the inner tube.

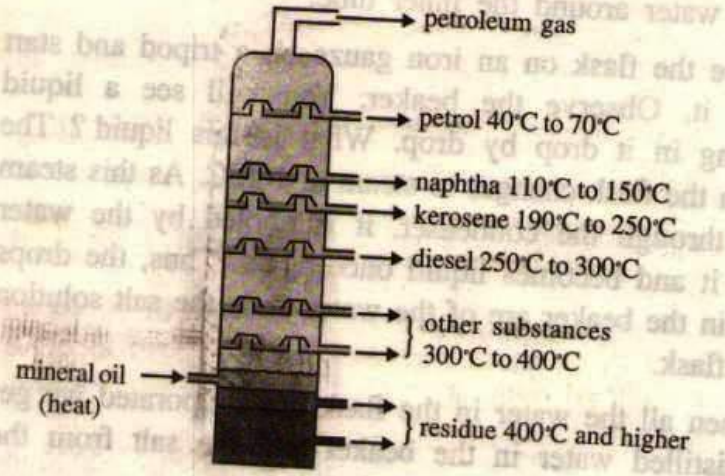
Place the flask on an iron gauze on a tripod and start heating it. Observe the beaker. You will see a liquid collecting in it drop by drop. What is this liquid ? The water in the flask changes to steam at 100°C. As this steam passes through the condenser, it is cooled by the water around it and becomes liquid once again. Thus, the drops falling in the beaker are of the water from the salt solution in the flask.

When all the water in the flask has evaporated we get pure distilled water in the beaker and the salt from the solution is left behind in the flask.

- Which method will you use to obtain salt from the sea water in salt pans – evaporation or distillation ?
- Which salt is obtained as a result of the chemical reaction between hydrochloric acid (HCl) and sodium hydroxide (NaOH) ? Which method will you use to separate it from the solution ?

Fractional distillation : The process of fractional distillation is similar to distillation except that there is a fractionating column between the distillation flask and the condenser. If several substances are dissolved in a liquid,

fractional distillation is the process useful for separating them. The crude oil obtained from oil wells yields various substances like petrol, naphtha, kerosene, diesel, etc. The components of crude oil are separated by the process of fractional distillation. Of these, petrol is the most inflammable and has the lowest boiling point followed by



naphtha, kerosene and diesel respectively. When crude oil is heated, petrol evaporates first. It is condensed and collected separately. Each of the other substances is separated at the proper temperature. **Separation of the various components of crude oil is possible because of the differences in their boiling points which is necessary for fractional distillation.**

- What method will you use to separate ethanol from a mixture of ethanol (boiling point 78°C) and water (boiling point 100°C) ?

- Could we separate water and petrol quickly without heating ?

Discuss : Express your opinions about the likelihood of a severe crisis of drinking water in the future and remedies and solutions to this problem.

Reviewing the Lesson

- Any given substance has a specific melting point and boiling point.
- The solvent and the solute in a solution can be separated by the process of distillation.
- If there is a significant difference between the boiling points of liquids, they can be separated from a mixture by fractional distillation.

Exercises

1. **Define.**
   (a) Melting point (b) Boiling point
   (c) Distillation.
2. **Draw a labelled diagram showing the process of distillation.**
3. **Give scientific reasons.**
   (a) A condenser has two taps.
   (b) At dawn, in winter, we see dewdrops on leaves of trees.

4. Match the following.

'A'	'B'
(a) Melting point	1. Separating common salt and water from their mixture.
(b) Boiling point	2. Obtaining diesel from crude oil.
(c) Fractional distillation	3. Change of state of a liquid into a gas.
(d) Distillation	4. Change of state from solid to liquid.

5. Answer the following questions.

(a) What will you do to find out the boiling point of water ?

(b) What changes do you see in the appearance of a candle after you have lit it ?

(c) Can a solid and a solvent be separated from their solution by distillation ?

Activity

- Find out how *ittars* are made.

13. Metals and Non-metals

You have previously learnt about elements. We see many objects and substances in our surroundings. They are all made from elements. Substances are in solid, liquid or gaseous states. Some solids are shiny, hard while some are soft, brittle and do not shine. For example, silver, copper, gold are shiny while wood, soil or chalk do not shine.

Try this : Look at the table below. What do you notice ?

Substance/Object	Lustre	Hardness	Elements
1. A copper vessel	✓	✓	copper
2. Sulphur powder	×	×	sulphur
3. An aluminium can	✓	✓	aluminium
4. Coal powder	×	×	carbon
5. A silver box	✓	✓	silver

Substances like copper, aluminium, silver have a shiny surface. They are hard. Coal and sulphur do not shine and can be powdered easily.

Elements can be divided into two kinds – metals and non-metals. Metals and non-metals have different properties.

Some physical properties of metals and non-metals

Malleability

Try this : Take an iron nail. Beat it with a hammer and flatten it. If you continue to hammer it, it becomes a thin flat sheet. Malleability is a property of metals.

Malleability is the ability of a solid to be formed into a thin sheet on beating.

Try hammering a piece of coal. It does not flatten into a sheet.

Observe this : Watch a blacksmith at work. He places a red hot piece of iron from a furnace on an anvil and beats it with a hammer. The hot iron is soft. The hammering turns it into a sheet and it can be given any desired shape.

Ductility : Ductility is the property of a material. It is its ability of being drawn into a wire. Metals can be drawn into wires. Platinum, gold are well-known as highly ductile metals. 2.5 km of platinum wire is known to have been drawn from 1.27g of platinum. Can we draw coal into a wire ? Can we beat it into a sheet ? Coal is nothing but carbon. Carbon is a non-metal. Non-metals are neither malleable nor ductile.

Conduction of heat and electricity : We use metal utensils for cooking food, because metals like iron and copper are good conductors of heat. Almost all metals are good conductors of heat and electricity.

Have you observed the electrical wiring in your house ? It has copper wires but the switchboard on the wall is made of wood or

plastic. It is because copper is a good conductor and wood and plastic are bad conductors of electricity. Substances that allow heat and electricity to flow through them are called conductors of heat and conductors of electricity respectively.

What is the gong of the school bell made of ? Metals produce a ringing sound. Non-metals do not produce a ringing sound. Study the other properties of metals and non-metals given in the table below.

Metals	Non-metals
1. Metals have a lustre.	1. Non-metals do not have lustre.
2. Metals are malleable. They can be beaten into thin sheets.	2. As non-metals are brittle, they are not malleable.
3. Metals are ductile. They can be drawn into wires.	3. As non-metals are brittle they are not ductile. They cannot be drawn into thin wires.
4. Metals are good conductors of heat and electricity.	4. Non-metals are poor conductors of heat and electricity.
5. At normal temperature, metals are in the solid state. Exception : Mercury. It is in the liquid state.	5. At normal temperature, non-metals are in the solid or gaseous state. Exception : Bromine is in the liquid state.
6. Ordinarily, metals have high densities.	6. Ordinarily, non-metals have low densities.

- What is the size of the sheet you can get from 1g gold ?
- Why is copper or silver used in coins ?
- Is diamond, which shines, a metal ?

Chemical properties of metals

Reaction with oxygen

(1) When metals react with oxygen, their oxides are formed.

Try this : You might have seen the bright light produced by burning a magnesium ribbon. When magnesium burns in air it combines with oxygen and forms magnesium oxide.

$$2Mg + O_2 \longrightarrow 2MgO$$

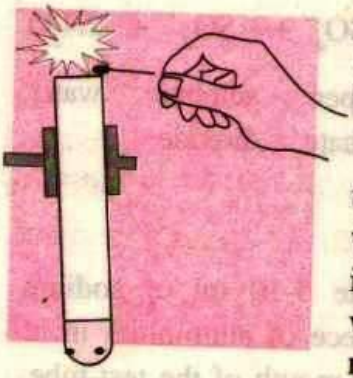
magnesium oxygen magnesium oxide

(2) Iron, left exposed in moist air, rusts. A reddish substance is formed on its surface. This is the chemical reaction of iron with the oxygen in the air.

Try this : Take some water in a test-tube. Add some magnesium oxide to it. Shake the test-tube. Test the water in it with red and blue litmus paper. What do you see ? The red litmus paper turns blue. It means that, **oxides of metals are alkaline in nature.**

The action of acids on metals

Try this : Take 4 test-tubes and label them A, B, C and D. Place a magnesium ribbon in A, a thin sheet of aluminium in B, iron filings in C and a copper wire in D. Now, using a dropper, add 5 ml of dilute hydrochloric acid to each of the test-tubes. Observe the reactions carefully. If a reaction does not take place, heat the test-tube slightly. Now, take a burning matchstick near the mouth of each of the test-tubes. What do you see ? You hear a little popping sound as you take the matchstick near each test-tube.



Hydrogen gas is released in the reaction of most of the metals with an acid. As hydrogen is inflammable, it burns with a pop when a burning matchstick is taken near the mouth of the test-tube.

Test-tube A

$$\underset{\text{magnesium}}{Mg} + \underset{\text{hydrochloric acid}}{2HCl} \longrightarrow \underset{\text{magnesium chloride}}{MgCl_2} + \underset{\text{hydrogen}}{H_2}$$

Test-tube B

$$\underset{\text{aluminium}}{2Al} + \underset{\text{hydrochloric acid}}{6HCl} \longrightarrow \underset{\text{aluminium chloride}}{2AlCl_3} + \underset{\text{hydrogen}}{3H_2}$$

Test-tube C

$$Fe + 2HCl \longrightarrow FeCl_2 + H_2$$

iron — hydrochloric acid — ferrous chloride — hydrogen

Test-tube D : Copper does not react with hydrochloric acid at normal or high temperature. It dissolves in hot concentrated sulphuric acid and produces a solution of copper sulphate and sulphur dioxide gas.

$$Cu + 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$$

copper — sulphuric acid — copper sulphate — sulphur dioxide — water

The action of bases on metals

Try this : In a test-tube, take 5-10 ml of sodium hydroxide solution. Drop a thin piece of aluminium in it. Take a burning matchstick near the mouth of the test-tube. You will hear a popping sound. It tells you that the gas that burnt was hydrogen.

When bases react with metals, hydrogen gas is released.

Remember : Carry out the experiments only in the presence of your teacher.

- How do we clean silver or brass articles that have got tarnished ?

Some uses of metals

1. Because of the special properties of metals, they are widely used for making cooking utensils.

2. Copper wires are mainly used as conducting wires, and in electrical gadgets, radios, refrigerators, etc.
3. Iron and aluminium sheets are used to make roofs of houses.
4. Gold, silver, tin are used to make coins and ornaments.
5. Mercury is used in thermometers.
6. We use compounds of sodium such as the common salt (sodium chloride), washing soda (sodium carbonate), baking soda (sodium bicarbonate) for many purposes in everyday life.

Uses of non-metals

1. Graphite is used as the core (lead) in pencils.
2. Graphite is used as one electrode in an electro-chemical cell.
3. Silicon dioxide, the oxide of the metalloid silicon, is used in making glass and cement.

4. Silicon is used in the solar cell.

5. Red phosphorus is of great use for various purposes such as making safety matches, crackers, germicides, explosives, etc.

6. Sulphur is used for producing acids and also in some medicines, gun-powder, etc.

The noble metals : Metals like platinum and gold are found in nature in the form of elements. They are not affected by air, water, acids, heat, etc. Hence, they are called the noble metals. They do not ordinarily take part in chemical reactions.

Uses of noble metals

1. Gold and platinum are mainly used for making ornaments.

2. Gold coins were used in olden times.

3. Gold is used for plating silver.

4. Platinum is used in some medical instruments.

The purity of gold : The purity of gold is measured in carats. Twenty-four carat gold is gold of 100% purity. The purity of gold determines its price. However, 24-carat pure gold is very soft. Ornaments of pure gold break or get bent easily. So, copper or silver is added to gold in the necessary proportion. Ordinarily, twenty-two carat gold is used for making ornaments.

Observe the percentage of gold in gold of different purities.

Carat	Percentage of Gold
24	100
22	91.8
18	75
14	58.5
12	50
10	42

Corrosion : Iron articles slowly get covered with a reddish substance. If copper vessels remain wet, they develop yellowish green patches. Silver articles turn black.

In all the above examples, the gases present in air react with the metals iron, copper or silver due to moisture, to produce compounds of the metals. This action that wears the metals is known as corrosion.

Oxygen gas reacts with iron, carbon dioxide gas, with copper and hydrogen sulphide gas with silver.

To prevent the corrosion of metals, a layer of grease or oil is applied to them or they are coated with another metal that does not rust. Iron is galvanized (given a coating

of zinc) to prevent rusting. Ships are coated with enamel paints to prevent the corrosion of the metal sheets by the salty sea water. These paints contain metals like zinc or magnesium. This prevents contact between the metal surface and the surrounding air. Therefore, chemical reactions cannot take place and corrosion is prevented.

Alloys : A homogenous mixture of two or more metals or of metals and non-metals is called an alloy. Alloys contain metals in specific proportions. In the alloy physical properties change but chemical properties remain the same.

For example, when copper and tin are mixed we get the alloy called bronze. In the alloy, copper loses its softness and the alloy becomes hard.

The alloy steel is obtained from iron and carbon. It is a stronger material. Iron, carbon, chromium and nickel form the alloy called stainless steel. It is more durable and clean. It does not rust.

Reviewing the Lesson

- Elements are of two kinds – metals and non-metals.
- Lustre, malleability, ductility and conductivity are some of the properties of metals.
- Non-metals are generally brittle and bad conductors of heat and electricity.

- Metals combine with oxygen in the air to form their oxides.
- Metals react chemically with acids to form compounds of metals.
- Gold, platinum do not ordinarily react chemically. They are called noble metals.
- Metals and non-metals have many industrial and everyday uses.

Exercises

1. Answer the following questions.

(a) Why is it possible to draw silver into a wire when even a long pencil-point breaks so easily ?

(b) Why is copper used for electrical wiring in our houses ?

(c) Why does a copper vessel shine again after scrubbing ?

(d) Give two characteristics of alloys.

(e) What is meant by corrosion ?

2. Give scientific reasons.

(a) Gold and silver are used in coins.

(b) Ornaments are generally not made from 24-carat gold.

(c) Ships are painted at frequent intervals.

(d) Gold and platinum are called noble elements.

(e) Stainless steel has more lustre than iron.

3. Match the following.

'A'	'B'
(a) Mercury	1. Alloy of iron, carbon, nickel, chromium
(b) Graphite	2. Alloy of iron and carbon
(c) Sulphur	3. The 'lead' in a pencil
(d) Steel	4. Medicines
(e) Stainless steel	5. Thermometer

4. Fill in the blanks.

(a) Gold of 100% purity is ..... carat gold.

(b) Bronze contains the metals ..... and ..... .

(c) The ..... gas is released when metals react chemically with acids.

(d) Oxides of metals have ..... properties.

(e) The non-metal ..... is used in gun powder.

Activities

(1) Find out which metals are used to make *varakh*, the shiny foil, that is used to garnish sweetmeats.

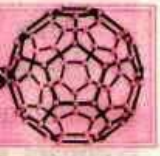
(2) Find out how *varakh* is made.

(3) Find out which metal on the basis of health considerations, should be used to make *varakh*.

(4) Observe how the metal tyre is fitted on the wheel of a bullock-cart.

(5) Cooking vessels are made of various metals. Which foods are made in the vessels of which of the following metals : aluminium, copper, iron, stainless steel, brass ?

14. Carbon and Carbon Compounds



Carbon

Carbon is a non-metallic element. It is found in the free state in nature as graphite and diamond and also in compounds.

Try this : Take silk, wood, fruit seeds, hair, feathers, in separate test-tubes and heat each of them. What do you see ? Slowly their colour changes and finally they all turn black. They are all transformed into carbon when charred. What does this tell you ?

All plant and animal products contain carbon as their main constituent.

Carbon is found in carbon dioxide in the air, as also in fuels like biogas, petroleum and marsh gas.

Carbon has atomic number 6 and atomic mass number 12. Its valency is 4.

How did coal form in nature ?

Coal is a widely used fuel or energy source. From where does coal get the energy it contains ? Plants and animals constantly receive solar energy. Lakhs of years ago the remains of plants and animals got buried under the earth. Micro-organisms acted on them and the gaseous substances in these remains were released into the atmosphere and what was left behind consisted mainly of carbon compounds.

After this, under tremendous pressure in the bowels of the earth, the liquid substances in these compounds drained away and the remaining mineral solidified into compact and hard rock. This is the material we call coal.

Coal is of different types. It is graded on the basis of the heat that can be obtained from it. In spite of other energy sources like mineral oil and electricity being available, we obtain 80% of the energy we need from organic fuels.

Types of coal	Percentage of carbon
1. Anthracite	80 %
2. Bituminous coal	60 %
3. Lignite	22 %
4. Peat	11 %

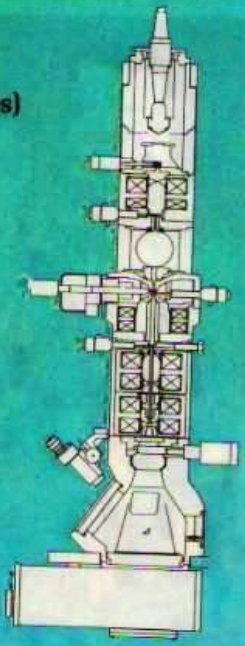
- What common feature is there in sugar, paper, plastic, wood, cereals, pulses and petrol ?

Properties of carbon

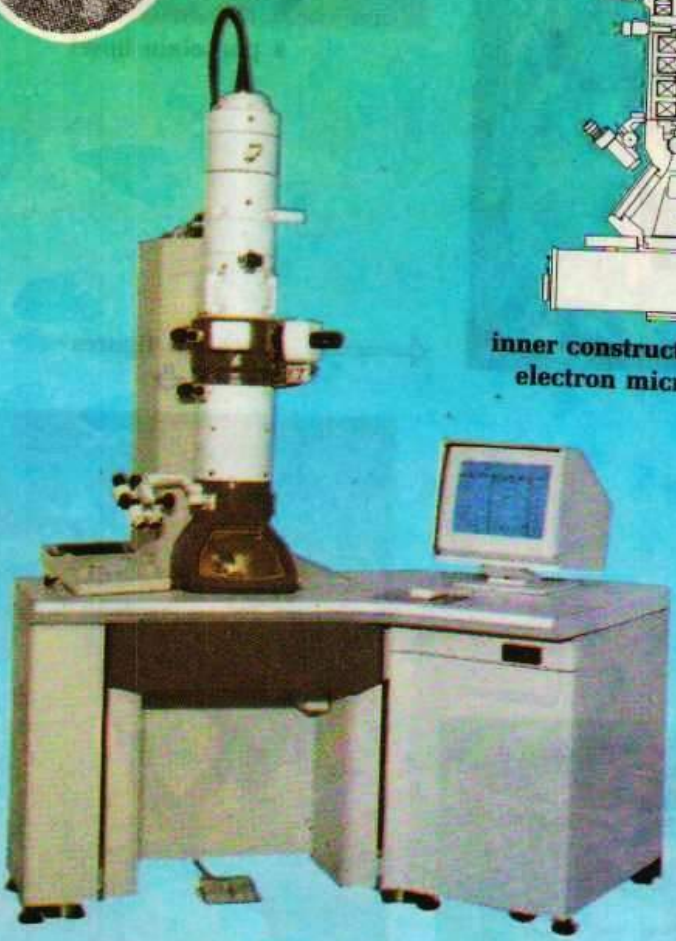
Allotropes : In nature, some elements are found in more than one form. Even though the chemical properties of these forms are the same, they have different physical properties. These forms are called allotropes of an element and this property of the element is called allotropy. Carbon, sulphur and phosphorus are some of the allotropic elements found in nature.

Allotropes of carbon : Allotropes of carbon are of two types, crystalline and amorphous or non-crystalline.

a hepatitis virus
(magnified 114,000 times)



inner construction of an electron microscope



an electron microscope
Courtesy : National Institute of Virology, Pune.

a porcelain bowl

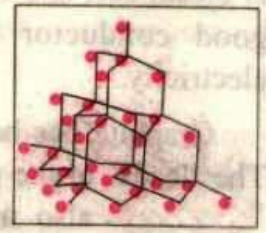
⇦ porcelain figures

⇩

a glass bowl

The crystalline allotropes are diamond, graphite and fullerene. The atoms of the elements in a crystalline form have a specific arrangement. In the amorphous form, the arrangement of atoms is irregular. The amorphous forms of carbon are coke, coal, etc.

Diamond : Diamonds were formed lakhs of years ago, by the crystallization of carbon under tremendous pressure.



Brilliant, pure diamond is an extremely hard substance. It is a bad conductor of electricity.

In the diamond crystal, every carbon atom has four atoms of carbon at specific distances around it.

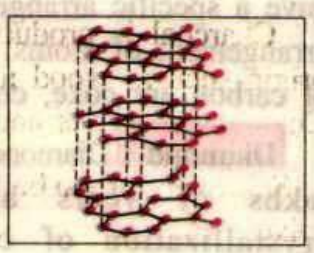
If diamond is heated to a very high temperature, it gives out carbon dioxide. Acids and alkalies do not have any effect on diamond. Diamond is used to cut glass, and in drilling machines and as an ornament.

Synthetic diamonds are made by subjecting pure carbon to extremely high pressure and heating it to a very high temperature.

- What makes a diamond shine ?
- What is the main difference between diamond and glass ?
- Where are the diamond mines in India located ?

Graphite : A graphite crystal is hexagonal. The regular arrangement of atoms in graphite is in layers. Thus, 6

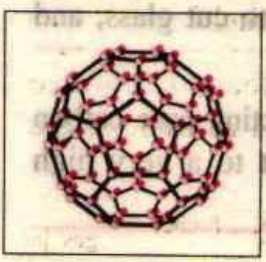
carbon atoms form a hexagon and are at specific distances from one another. Every carbon atom has three other carbon atoms around it at equal distances.



The graphite found in nature is black, soft and smooth. It is a good conductor of heat and electricity.

Graphite has been used for writing since olden times. The 'leads' in the pencil are made of graphite. Graphite is also used for lubrication. In the dry cell, a graphite rod forms the positive electrode. Graphite is also used in arc lamps or arc lights which give bright light.

Fullerene : Fullerene is a recently discovered allotrope of carbon. The atoms in the allotrope of carbon known as C_{60} or buckyball are joined to each other in pentagonal and hexagonal arrangements. As a result, the structure of the fullerene is like a football.



Fullerenes were named after the architect **Richard Buckminster Fuller**, from the kind of domes he had built.

The Nobel Prize for chemistry in 1996 was awarded to Harold Kroto, Robert Curl and Richard Smalley for the C_{60} form of carbon.

Properties of fullerene are still being studied. Scientists believe that it could be used in the revolutionary research related to superconductivity.

The most familiar form of carbon is charcoal. It is an amorphous form of carbon.

Charcoal is produced by burning substances of plant origin such as wood in an insufficient supply of oxygen. Charcoal is porous and, therefore, has a low density.

Solubility of carbon : Carbon does not dissolve in any solvent.

Action of carbon with oxygen : When carbon is burnt in air it combines with oxygen and forms carbon dioxide gas.

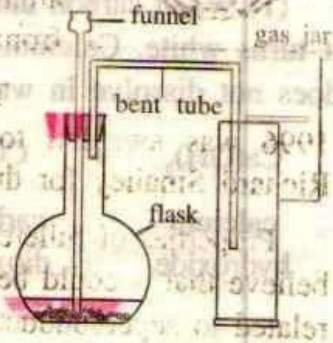
$$C + O_2 \longrightarrow CO_2$$

carbon oxygen carbon dioxide gas

- Which coal is used for purifying water ?
- Why is charcoal brittle ?
- Why is charcoal used as a domestic fuel ?

Carbon dioxide : Carbon dioxide is found in the free state in air. It is given out into the air as a result of the respiration of plants and animals.
It is found in chalk, shahabad stone and limestone in compound form.

Laboratory preparation of carbon dioxide : Place some pieces of calcium carbonate (limestone) in a flask. Set up the apparatus as shown in the diagram.



Through a funnel that reaches the base of the flask, pour some dilute hydrochloric acid. Ensure that the lower end of the funnel tube dips into the hydrochloric acid. A chemical reaction takes place between calcium carbonate and hydrochloric acid and the carbon dioxide that evolves will collect in the gas jar by upward displacement of air.

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$$

calcium	hydrochloric acid	calcium chloride	water	carbon dioxide

- What happens when lemon juice spills on the marble kitchen counter ?

Physical properties : Carbon dioxide is a tasteless, odourless, colourless gas. It is heavier than air. It dissolves sparingly in water.

Try this : Hold a lighted candle in the gas jar filled with carbon dioxide. It gets extinguished. This tells us that carbon dioxide neither burns nor supports burning.

Some chemical properties

(1) When carbon dioxide is passed through lime water, it turns white. Calcium carbonate is white in colour and does not dissolve in water.

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

calcium hydroxide	carbon dioxide	calcium carbonate	water

(2) When carbon dioxide reacts with oxides of metals, carbonates of those metals are formed.

$$CaO + CO_2 \longrightarrow CaCO_3$$

calcium oxide — carbon dioxide — calcium carbonate

(3) When carbon dioxide is passed through water it dissolves a little in it forming carbonic acid.

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

carbon dioxide — water — carbonic acid

(4) When carbon dioxide is passed through a solution of sodium hydroxide, sodium carbonate is formed.

$$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$$

sodium hydroxide — carbon dioxide — sodium carbonate — water

(5) If carbon dioxide is passed through a solution of sodium carbonate, sodium bicarbonate is formed.

$$Na_2CO_3 + H_2O + CO_2 \longrightarrow 2NaHCO_3$$

sodium carbonate — water — carbon dioxide — sodium bicarbonate

The fire extinguisher : It consists of a cylinder filled with a solution of sodium bicarbonate. There is also a capsule of dilute sulphuric acid in it. When the knob is pressed the acid in the capsule spills on the sodium bicarbonate. As a result of the chemical reaction that takes place, carbon dioxide is produced and it gushes out of the cylinder.

$$2NaHCO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O + 2CO_2$$

sodium bicarbonate	sulphuric acid	sodium sulphate	water	carbon dioxide

Uses

1. Carbon dioxide is used to produce aerated cold beverages.
2. Carbon dioxide is used to produce dry ice.
3. Carbon dioxide is used to extinguish fires.
4. Carbon dioxide is used to make washing soda.
5. Carbon dioxide is used to produce sodium bicarbonate (soda-bi-carb or baking powder).
6. Plants make their own food by using carbon dioxide.

- Why do food preparations become light and crisp when baking soda is used ?
- What is caustic soda ? Where is it used ?

Methane : Methane is the first in the series of combustible hydrocarbon compounds that are formed when carbon combines with hydrogen. The molecular formula of methane is CH_4. This molecule has one carbon atom and four hydrogen atoms.

In nature, methane is formed in marshes, which is why it is called marsh gas. It cannot be liquefied by applying pressure. Hence, it cannot be filled in a cylinder but has to be piped to the place where it is to be used.

If methane gas is ignited in air, it burns rapidly with a blue flame. It has great importance as a naturally available fuel.

Production of methane

You might have seen a biogas plant. Which gas is formed in it ? We obtain methane in a biogas plant.

(1) In a biogas plant, methane is produced anaerobically, i.e., in the absence of air, from plant and animal waste.

(2) In a laboratory, methane is produced by heating a mixture of hydrogen and carbon monoxide to 300°C in the presence of the metal nickel.

$$\underset{\text{carbon monoxide}}{CO} + \underset{\text{hydrogen}}{3H_2} \xrightarrow{\text{nickel}} \underset{\text{methane}}{CH_4} + \underset{\text{water}}{H_2O}$$

Properties : Methane is an odourless, tasteless and colourless gas. It is lighter than air and does not dissolve in water.

Methane is highly inflammable and burns with a blue flame.

$$\underset{\text{methane}}{CH_4} + \underset{\text{oxygen}}{2O_2} \longrightarrow \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water vapour}}{H_2O} + \text{Heat}$$

Uses : (1) Methane is mainly used as a fuel.

(2) It is also used to produce acetylene, another carbon compound.

- Is carbon dioxide always formed when a hydrocarbon is burnt ?
- What is the difference between methane and the gas in the cylinder we use at home ?

Reviewing the Lesson

- Carbon has two kinds of allotropes – crystalline and non-crystalline.
- The crystalline forms of carbon are diamond, graphite, fullerenes while coke, soot and charcoal are the non-crystalline forms.
- There are many compounds of carbon, such as carbon dioxide, methane.
- Carbon dioxide is used for extinguishing fires.
- Methane is the hydrocarbon compound obtained in the biogas plant.
- Carbon, carbon dioxide and methane have many uses in everyday life.

Exercises

1. Answer the following questions.

(a) What is meant by allotrope ? Which are the allotropes of carbon ?

(b) How is carbon dioxide gas produced in the laboratory ?

(c) Why is graphite used as a lubricant ?

(d) How is charcoal made ?

2. Give scientific reasons.

(a) Diamond is used to cut metals.

(b) Carbon dioxide is used for putting out fires.

3. Fill in the blanks.

(a) ..... is a good conductor of heat and electricity.

(b) Fullerene is an ..... of carbon.

(c) ..... turns limewater milky.

(d) Charcoal is an ..... of carbon.

(e) Diamond is a ..... conductor of electricity.

(f) A biogas plant produces ..... gas.

4. Match the following.

'A'	'B'
(a) Fullerene	1. Na_2CO_3
(b) Graphite	2. Cutting metals
(c) Diamond	3. Hexagonal arrangement of atoms
(d) Washing soda	4. C_{60}

5. Give two uses of :

(a) Carbon (b) Carbon dioxide (c) Methane

6. Differentiate between :

(a) The crystalline and non-crystalline or amorphous forms of carbon.

(b) Diamond and graphite.

Activity

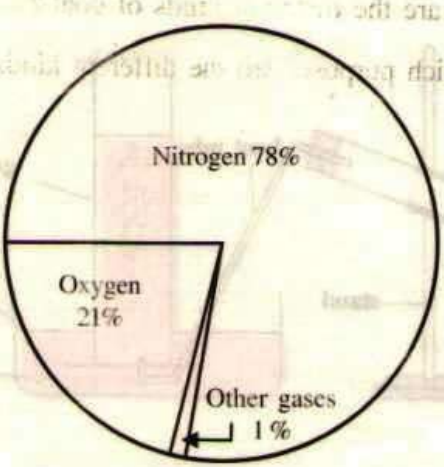
- Find out the answers to the following questions by visiting a warehouse for coal.

  (1) Which are the different kinds of coal ?

  (2) For which purposes are the different kinds of coal used ?

15. Air

There is a thick envelope of air all around us. We call it the atmosphere. Air contains oxygen, nitrogen, carbon dioxide, water vapour and some inert gases.



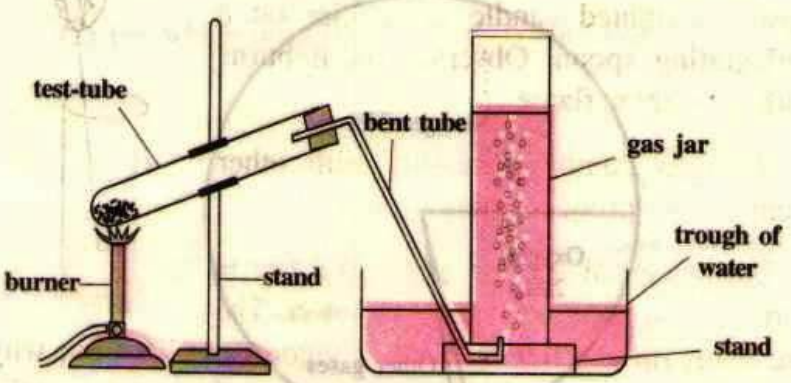
Other gases: Carbon dioxide, water vapour, inert gases and other constituents

- About a hundred years ago, the proportion of carbon dioxide in air was about 0.029%. Today it is 0.035%. What is the reason ?

Oxygen : Oxygen is found in air in the free state. It is also present in water in the dissolved state. The survival of living things depends upon oxygen.

Preparation of oxygen in the laboratory

To prepare oxygen, take a mixture of potassium chlorate and manganese dioxide in the proportion 5 : 1, in a test-tube. Set up the apparatus as shown in the figure. Heat the test-tube to 300°C. You will see gas bubbles rising into the water filled gas jar inverted over the water. Fill three or four jars with the gas.



How will you know that the gas jar is full ? Oxygen takes the place of water in the gas jar. As oxygen fills more and more of the space in the gas jar, the level of water in it keeps falling. Oxygen is slightly heavier than air. It is collected by the downward displacement of water.

$$2KClO_3 \xrightarrow[(MnO_2)]{\text{Heat } 300^{0}C.} 2KCl + 3O_2$$

potassium chlorate → potassium chloride + oxygen

Remember : Manganese dioxide does not actually take part in this reaction. It acts as a catalyst.

Physical properties : (1) Oxygen is a colourless, odourless, tasteless gas.

(2) It dissolves sparingly in water.

Chemical properties

Try this : Take a gas jar full of oxygen. Lower a lighted candle in the jar on a deflagrating spoon. Observe that it burns with a brighter flame.

Oxygen combines readily with other elements to produce their oxides.

Try this : When the wood in a fire is burning low, blow on it with a blower. The fire flares up and begins to burn vigorously. Find out why this happens. After some time the burning slows down again. **Oxygen does not itself burn but supports burning.**

- Why does the fire go out if water is thrown on the burning wood ?
- Why does an electric light burn even when there is no oxygen in the bulb ?

Uses of oxygen

(1) Living things need oxygen for respiration.

(2) If a person cannot breathe then oxygen is supplied artificially.

(3) Mountaineers and divers are supplied with oxygen from cylinders.

(4) Flames of the mixtures oxyhydrogen (temperature 2,800°C) and oxyacetylene (temperature 3,300°C) are used for welding.

■ What is the function of the blacksmith's bellows ?

Nitrogen : The greatest proportion of air consists of nitrogen. Nitrogen is an important constituent of proteins. Hence, it is important for the growth of living things. However, nitrogen cannot be used directly from the air. Nitrogen fixation is necessary before it can be used.

Nitrogen fixation : The conversion of atmospheric nitrogen into compounds like ammonia and nitrates which can be used by living things is called nitrogen fixation. This is brought about by both biological and atomspheric factors.

Biological fixation : Micro-organisms that bring about nitrogen fixation are of two kinds. One of these types are found in the nodules on the roots of certain plants while the other types are found in the soil. The micro-organisms in the nodules absorb the nitrogen from the air and convert it into nitrogen compounds.

The micro-organisms in the soil convert atmospheric nitrogen into ammonia, nitrous acid and nitric acid and eventually into nitrates.

Atmospheric fixation : When there is lightning in the sky, atmospheric nitrogen and oxygen combine to form nitric oxide. This nitric oxide is oxidized again and nitrogen dioxide is formed.

Nitrogen dioxide dissolves in rainwater and finally forms nitric acid. This nitric acid falls to earth, dissolved in rainwater. There it reacts with the salts in the soil to form nitrates. Plants use these nitrates for their own growth.

Thus, nitrogen in the air becomes available to living things after biological and atmospheric fixation.

Through excretion and decay of living things as well as through burning, nitrogen compounds get decomposed. Thus, nitrogen is released back into the atmosphere. That is how the proportion of nitrogen in the atmosphere remains constant.

Some uses of nitrogen

(1) Nitrogen is useful for the growth of living things. Plants get nitrogen from the soil in the form of nitrates and fertilizers. This helps them to grow. Plants use this nitrogen to produce proteinaceous substances. Other living things use plants as food. This helps them grow, too.

(2) Nitrogen is used for producing fertilizers.

(3) Nitrogen is used in industry for the large scale production of ammonia and nitric acid.

(4) Nitrogen is used to make thermometers for measuring very high temperatures.

Carbon dioxide is present in air

Plants use carbon dioxide from the air during photosynthesis and release oxygen into air. This process takes place in the presence of sunlight.

At present, we find that the proportion of carbon dioxide in the air has risen. There is danger of it rising even higher in future. This rising proportion of carbon dioxide increases the threat from the greenhouse effect.

Try this : You must have seen the gas that gushes out of a bottle of an aerated drink when you open it. This gas is carbon dioxide. Why does it gush out like this ?

Carbon dioxide dissolves only sparingly in water. Hence, it has to be dissolved in water under pressure. When the cap of the bottle is prised open, the pressure is released and the carbon dioxide gas gushes out.

If carbon dioxide is cooled to $-57^{0}C$, it freezes. In this form, it is called dry ice. Dry ice is used to bring down the temperature of a substance suddenly. It is also used for preserving foodstuffs.

- How does carbon dioxide cause global warming ?

There is water vapour in air

Try this : Take a clean glass. Dry its outer surface. Place some pieces of ice in the glass. You will soon see little droplets of water collecting on the outer surface of the glass. Check it by drawing a finger over it. The water vapour in the air condenses and collects on the glass in the form of fine droplets.

Some deliquescent substances absorb water vapour from the air. This too, tells of the presence of water vapour in the air. Clouds and fog are formed by the condensation of water vapour.

Inert gases are present in air : The inert gases argon, helium and neon, which are among the other constituents of air, have many uses. Of these, argon is used in electric bulbs, helium is used to obtain very low temperatures while neon is used in the neon lights on hoardings that display advertisements.

- Why does common salt become wet in the rainy season ?
- A pouch of a chemical powder is placed in some bottles of medicines. What is this chemical ? Why is it placed there ?

Air pollution : Industrialization is taking place at a rapid pace. The number of factories is on the rise. The

waste chemicals given out by factories are in gaseous, liquid as well as in solid state. They are let out into the atmosphere, water and soil.

When such chemical substances collect in any place beyond a certain level, their harmful effects can be seen. This is called pollution.

Pollution is being caused by effluents from factories. These include contaminated water, dust, soot, chemicals, especially gases released in the atmosphere by the burning of carbon and sulphur. Lead, aluminium, zinc, acids, bases, etc also cause pollution.

Atmospheric pollution leads to a higher incidence of respiratory disorders, cancer of the intestines, disorders of the urinary bladder, high blood pressure, disorders of the eyes, etc. It also causes palpitations and psychological disorders, too.

It is now accepted that pollution affects animals and plants, too. Not only has the life-span of animals decreased, but their capacity for producing milk is also seen to be decreasing.

There is a fall in the photosynthetic production by plants also. Other effects, like untimely falling of leaves, absence of fruiting, etc have also been seen on plants. The government and the public have both taken up the task of controlling atmospheric pollution on a war footing. Some of the remedies are as follows :

(1) A law has been enacted making it mandatory to treat chemical waste before letting it out of a factory.

(2) Efforts must be made to make changes in the chemical processes themselves so as to avoid the generation of harmful chemical substances.

(3) Precautions should be taken to prevent the concentration of chemicals in any one place.

(4) To prevent the harm caused by air pollution, industrial estates should be established away from cities and the height of their chimneys should also be increased.

(5) Engines of motor vehicles should be serviced and maintained properly to prevent them from causing pollution.

(6) Forests should be grown to help reduce pollution of air.

- What dangers will we have to face if the proportions of oxygen and nitrogen in the air undergo a change ?
- What is the use of atmospheric ozone ?

Acid rain

Factories in big cities emit nitrogen dioxide and sulphur dioxide gases. As rain falls, these gases dissolve in it forming nitrous acid and sulphurous acid. With the rainwater, these acids fall to the ground. This is what is called acid rain. This can sometimes cause trees to die and fall. Acid rain also causes yellow patches on marble.

The functions of the observatory

An observatory records observations of atmospheric factors such as temperature, pressure, velocity of winds and humidity. It keeps a record of the changes occuring in them and forecasts the weather based on the changes observed.

Observations of weather are recorded every hour with the help of machines and are carried out in person once every day. Scientists of the India Meteorological Department at Pune have developed a system which can accurately predict the arrival of the south-west monsoons. Research related to several different subjects such as atmospheric ozone, Antarctica, storms, cyclones, pollution in suburban areas, etc is carried on there.

Reviewing the Lesson

- The main constituents of air are nitrogen, oxygen and carbon dioxide.
- Respiration in living things and burning are the important uses of oxygen.

- Nitrogen in the air helps in the nourishment of plants and animals.
- Increasing population and industrial growth causes atmospheric pollution.
- Efforts are being made both by the government and society to arrest pollution.

Exercises

1. Answer the following questions.

(a) Name the constituents of air and give their proportion in air.

(b) Of what use is carbon dioxide to plants ?

(c) What is meant by nitrogen fixation ? How does it happen ?

(d) Which measures are necessary for arresting pollution ?

(e) What ill-effects of pollution are being seen ?

(f) What function does an observatory perform ?

2. Give scientific reasons.

(a) The danger from the greenhouse effect is rising.

(b) The proportion of nitrogen in air remains constant.

(c) When a bottle of an aerated drink is opened, the drink inside gushes out in a stream of bubbles.

3. Fill in the blanks.

(a) Oxygen ..... burn, but ..... burning.

(b) Some ..... substances absorb ..... from the air.

(c) It is mandatory to treat ..... before letting them out.

(d) Solid carbon dioxide is also called ..... .

4. Match the following.

'A'	'B'
(a) Potassium chlorate	1. Catalyst
(b) Micro-organisms	2. Nitrogen
(c) Greenhouse effect	3. Carbon dioxide
(d) Fertilizers	4. Oxygen
(e) Manganese dioxide	5. Nitrogen fixation

5. Who am I ?

(a) I am found in clouds and mist.

(b) I am used in aerated drinks.

(c) I am used in an electric bulb.

(d) I form 78% of air.

(e) I am used in the production of nitric acid.

Activities

(1) Find out which ingredients used in baked products make them light and porous.

(2) Now-a-days, every motor vehicle is subjected to a 'pollution under control' (PUC) test. Find out why this test is done.

16. Soil

Soil gives support and nourishment to plants and thus helps them grow. Soil is the very base of agriculture. The survival of all animals, their nourishment and nurture all depends on the soil.

How is soil formed ?

Soil is made up of stones and pebbles, sand, fine soil particles as well as organic substances.

Changes in atmospheric heat and cold, winds, etc have an effect on rocks. Rocky surfaces develop cracks. Extreme heat and cold also cause cracks in rocks. Water that collects in these cracks freezes in the cold. Freezing water increases in volume and results in the breaking of the rock.

Rocks and boulders also break as a result of the effects of rivers, rainwater, winds and continuous changes in weather. Such continuous wearing of rocks converts them into smaller and smaller particles and they are eventually turned into soil. Layers of this soil spread over the surface of the earth.

In short, the effects of the various elements of nature are the cause of the wearing of rocks and formation of soil. This process of the transformation of rocks into soil is called 'weathering'.

Insects and micro-organisms live, grow and die in the soil. Plants, too, take root, grow and die in this same soil.

Rodents like rats make burrows in the soil to live in them. This results in the conversion of rough earth into soil, due to crumbling. Such biological process go on in the ground continuously and add to the effects of weathering.

Roots of plants growing into cracks in rocks also help the process of weathering. The soil that is formed by the weathering mainly caused by the roots of plants, is clay. It takes 800 to 1000 years for a 2.5 cm thick layer of fertile soil to be formed in nature.

■ Why is the earthworm said be the farmer's friend ?

Soil - a natural resource : You have seen that plant life has developed because of the presence of soil. Without soil, plant life could not have established itself on earth. Animal life could not have developed in the absence of food. Plants provide food for animals and human beings. They also provide us wood for building shelters. The clothes we wear to protect ourselves from the elements are also obtained from plants. In other words, plants provide us with all our basic necessities – food, shelter and clothes. Various minerals and metals are also obtained from the soil. Rainwater collects among the rocks, and this water too, becomes available to us. As the life of plants depends upon the soil, soil becomes an important factor in the life of human beings. Thus, soil is a natural resource.

Uses of soil : Soil has the property of plasticity, that is, it can be given any desired shape. When articles made from clay are baked, the minerals in the soil melt and while cooling bind other particles of soil together. This, makes the baked articles hard.

Soil has many other uses besides the nurture of plants. An important property of soil is that it holds water. As a result, water becomes available to us all the year round from deep places such as ponds and wells where it has collected naturally.

Bricks used for construction work, some vessels of everyday use are made from clay soil. The walls of some houses are also made of clay.

- What is meant by terra cotta ? What are its uses ?

The colour of soil

Soil is of different colours. It may be black, red, yellow or copper coloured. Colour is an important property of soil. Several processes occur simultaneously giving soil its colour. We get an idea of the fertility, drainage and other such properties of soil from its colour. The colour

of soil depends upon its texture, organic content, and chemical substances like iron, quicklime that it may contain.

Fine particles of quartz, felspar, mica, carbonates of metals, oxides and sulphides of iron are present in soil along with organic matter.

China clay, clay and loamy soil are the three types of soil used to make earthen pots and other artifacts.

The soil found near the Kaolin mountain in China is called kaolin or china clay. It is white in colour and is used to make crockery, tiles for bathrooms, tanks, laboratory apparatus, etc.

Various kinds of oxides are used to decorate earthenware or porcelain articles. Iron oxide is used to obtain red ochre, and copper oxide, to obtain the green colour.

Clay and loamy soil are different types of kaolin.

As loamy soil is white in colour it is used to make statues, idols, etc.

Soil particles are of different sizes. The proportion of the particles of the different sizes determines the texture of the soil. The different types of soil, based on its texture, are –

(1) Sandy soil
(2) Clayey soil
(3) Silt

If the soil has greater proportion of large particles or of sand, the soil is called sandy soil. Clayey soil has the

greatest proportion of fine particles of soil while silt soil consists of fine to medium-sized soil particles. Silt soil has medium capacity for holding water. Sandy soil has the least capacity for holding water while clayey soil has the greatest capacity for holding water. However, soil which holds a lot of water is not well aerated. This arrests the growth of roots in the soil.

- Which crops are grown in sandy soil ?
- Why is soil on river banks fertile ?

Try this : Take two boxes. Make small holes in their bases. Now, fill one box with a mixture of stones, sand and soil and plant a small seedling in it. Water it regularly. Take clayey soil in the other box, plant a seedling in it and water it regularly, too. Observe the plants after 8-15 days and record your observations.

Constituents of soil : Soil has constituents of plant and animal origin. They are called organic constituents. The constituents of plant origin include bacteria, fungii, algae, blue-green algae, decomposed leaves, etc of plants. The constituents of animals origin are protozoa, worms, insects, shells and the decomposed remains of dead animals.

Try this : Take a plastic box. Make a small hole in its base. Now gather some dried flowers, leaves, grass, coconut peelings, etc and place them in the box. Sprinkle water on it. Thus, one layer is formed.

After two or three days, make another similar layer on the first one. Make three or four such layers and plant a seedling in it. Observe the seedling.

Erosion of soil : Soil on the ground is eroded by rainwater falling on it, by fast currents of water flowing on it or by gusts of wind. This causes the thin layer of fertile soil on the surface to be carried away. The soil cover is reduced and the land loses its fertility.

To prevent erosion, soil must be kept covered. What gives this cover ? Grass allowed to grow, crops grown on the land and trees planted on it provide this cover.

Erosion depends upon the slope and the type of the soil. By arranging soil horizontally, across the line of the slope, soil erosion can be reduced.

If bunds are built to stop the flowing water, the soil that would have got washed away can be retained in place.

If soil erosion is arrested soil is conserved. This is called soil conservation. The government department for soil conservation is located at the district place. There, one can get information about how soil erosion can be reduced.

Social forestry : As people set up habitations near forests, forests began to be destroyed. Hence, priority is being given to efforts to save forests. In order to motivate even the common man to act upon the need for restoring forests, government schemes were started to plant trees in all possible places, such as on the borders of fields, on both sides of roads and railway tracks, on the banks of streams and rivers, etc. This is called social forestry. Government of India first started social forestry projects in the year 1976.

This project is meant to encourage small farmers and adivasis to plant trees. They are also given financial aid for this purpose. As a result fallow and barren land has been reclaimed for agriculture. The number of trees has risen and wood has become available in plenty. Because co-operation of the common man was sought and obtained for this project, land has now begun to be used as it should be used.

The social forestry project of the Maharashtra Government is carried out in most schools by teams called the *'Harit Sena'* or the 'Green Brigade'.

Soil pollution : A disturbance in the natural balance of the various factors present in soil is called soil pollution. When chemical fertilizers are used in greater quantities than necessary, when chemicals are sprayed as pesticides the proportion of chemicals in the soil increases. Soil is also polluted by the water let out from factories and by other causes such as acid rain. Using too much water and chemicals makes the soil saline. This also is a kind of soil pollution. Crops cannot grow well in such soil.

To prevent soil pollution we should use natural, that is, organic fertilizers rather than chemical fertilizers. We should also avoid overuse of fertilizers and pesticides. Effluents from factories should be treated properly before being let out.

Soil testing : Soil testing can tell us about the good qualities and shortcomings of the soil. A farmer grows a variety of crops. Often, he does not get a good harvest. Farmers often face some problems. At such times he has to take into consideration factors such as the colour, texture and content of organic matter in the soil. Soil testing helps to find out these things.

Reviewing the Lesson

- The various elements in nature affect rocks and cause them to wear and form soil.
- Soil is of different types based on its colour and texture. The utility of the soil depends upon the type of soil.
- Soil testing helps to find out the good qualities of the soil and also its shortcomings.
- When the balance between the natural constituents of soil is lost, soil is said to be polluted.

Exercises

1. Answer the following questions.

(a) What is soil made of ?

(b) Which are the constituents of plant origin in soil ?

(c) What steps can be taken to prevent erosion of soil ?

2. True or false ?

(a) The texture of soil can be determined from its colour.

(b) Soil is formed by the fast flowing currents of water.

(c) Sandy soil has little capacity for holding water.

3. Match the following.

'A'	'B'
(a) Algae	1. Farming on fallow land
(b) Soil erosion	2. Factors of plant origin
(c) Social forestry	3. Wind
	4. Factors of animal origin

4. Fill in the blanks.

(a) Plants satisfy man's basic needs for ....., ... and ..... .

(b) ..... and ..... are the organic constituents of soil.

(c) Land should be ..... to prevent erosion.

(d) Disturbance of the natural balance of soil is called soil ..... .

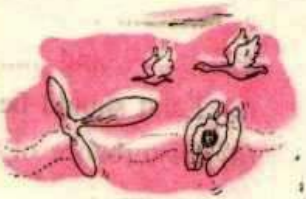
(e) The government has started the ..... project to protect forests.

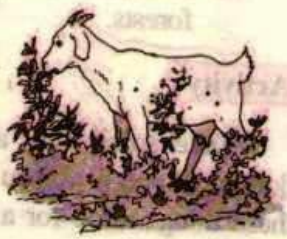
Activity

Take some clay and sprinkle water on it to make a soft dough. Shape it as you like to make things of your choice. Keep these things aside for a few hours. The clay will harden and your articles will be ready.

17. Agriculture

In nature, many plants grow naturally. Their seeds are dispersed naturally in the wild. Fruits growing on trees, burst open on drying. The seeds in them are carried away by the wind and water or by animals and scattered here and there. In favourable conditions, they take root and grow into trees. Seeds of the trees like the banyan and peepul are dispersed through the droppings of birds.





Things like the remains of dead animals, dry leaves, droppings of animals, all get buried in the soil and are transformed into manure. Seeds take root easily and plants flourish in such fertile soil. Rainwater helps their growth. Thus, plants are nurtured by nature itself.

Man observed nature and learnt to cultivate crops. Long ago, there were thick forests on the earth. It was man who

modern technology in agriculture - poly house

plants in the poly house

Red Dean bull

Red Sindhi bull

cleared these forests to make place for his own use. As he learnt that plants provide food, he began to grow them. He learnt to grow a variety of crops to meet his food related needs. He also studied plants and developed the science of agriculture in order to maximise the produce of the land.

Agriculture for food crops : Today, agricultural produce includes staple cereal foods like rice, wheat, jowar, bajra, maize, *ragi*, etc and pulses like *chana* (bengal gram), *moong* (green gram), *udid* (black gram), *tur* (*arhar*), *masoor* (lentils), *matki* (moth-beans), etc. Oilseeds are obtained by growing groundnuts, sesame (*til*), sunflower, safflower (*kardai*), linseed (*javas*) and soyabean. Vegetables like cluster beans (*gavar*), tomato, brinjals, snake gourd (*padval*), bitter gourd, (*karle*), *chakwat*, fenugreek (*methi*), country sorrel (*chuka*), colocasia (*alu*) are also grown besides fruits like mangoes, guavas, *chickoos*, jackfruit, oranges, pomegranates, bananas, etc. What do farmers grow besides food crops ?

As the demand for flowers has grown, floriculture has gained importance. The flowers grown include tuberoses, roses, marigolds, chrysanthemums as well as some foreign varieties of flowers.

The use of plants for medicinal purpose leads to the farming of serpentina, *gulvel*, asparagus, etc while jute, hemp, cotton are grown for their fibre to make yarn.

Plants like *raanbhendi*, parrot tree, jatropha are now being grown as alternative sources of fuel. This is called energy farming. Fuel is also obtained from wood and the bagasse of sugarcane.

When these plants are grown commercially, they are first grown in nurseries and the seedlings are then transplanted at their proper places. Greenhouses are used in nurseries and floriculture.

Now-a-days, there is an awareness about tree-plantation in view of the large scale cutting of trees. Trees like teak, eucalyptus, *subabhul* are being consciously planted.

- Which ingredients are used to make herbal tea ?
- Name five trees that grow in the wild (without being deliberately planted).

Agricultural practices : All that is done to obtain a good harvest, right from preparing the soil, using good seeds and fertilizers, to protecting the crop and storing it properly can be termed as farm-work or agricultural practices.

In our country, agriculture is carried on by traditional methods on the small scale and by modern methods on the commercial scale. The following are the important steps in farm work.

Tilling the land : This is an important stage in the process of farming. Activities related to tilling of the land are undertaken at three stages – pre-sowing, sowing and post-sowing stages.

Pre-sowing stage : At this stage, the land is ploughed and harrowed. By ploughing the field, the hard soil is dug up to a certain depth. The soil thus gets loosened. This helps the crop in many ways.

When the land is ploughed deep, the soil is turned up. This makes the soil friable and suitable for growing crops. Weeding becomes easier. The stubble and roots of previous crops become loose and are picked out. After that, the soil is evened out and the land is ready for sowing.

Loosening the soil exposes the germs and insects in it to the sun and thus kills them. Ploughing also helps to aerate the soil, that is, it helps air to enter deeper into the soil. This improves the respiration of the plants and their roots grow stronger and deeper.

Loose soil prevents water from flowing away from the surface and helps it to percolate into the soil. In other words, it improves the capacity of the soil to hold water.

- What is meant by irrigated land ?
- State the steps involved in tilling the land.

The sowing stage : This is the second step in tilling the soil. This includes arranging the soil and sowing the seeds or planting the seedlings.

1. Arranging the soil : A plough or harrow are used to arrange the soil. Soil is arranged in a way suitable for the crop to be grown. Soil may be arranged by cutting furrows, building ridges or making beds.

2. Sowing : After arranging the soil, the crop is planted. Have you ever watched seeds being sown or seedlings being transplanted ? It is done in various ways. The seeds may be scattered on the field or poked into the soil one by one or prepared seedlings may be transplanted.

Crops like rice are sown by *transplanting seedlings*. Seedlings are first grown in a seedbed. A seedbed is made by piling soft soil on the ground. Sugarcane is planted in furrows made in the soil. Ladyfingers are sown on ridges, while leafy vegetables are grown in beds.

The seeds of some varieties of cotton, as also those of pumpkin, bitter gourd and watermelon are sown by poking them into the soil one by one.

Post-sowing stage : Tilling activities of this stage begin once the crop has taken root. These include thinning of the crop, loosening the soil, weeding, watering and adding fertilizers, spraying pesticides, etc. It is important to carry out these activities at the right time.

1. Thinning the crop : This is an important stage of the post-sowing stage. It helps to prevent overcrowding. The number of plants is reduced by pulling some out. The plants left standing get adequate water and fertilizers and they grow vigorously. Roots that are exposed during the thinning are again covered with soil.

2. Loosening the soil and weeding : The sickle is used for these operations. Loosening the soil keeps the air moving freely around the soil.

3. Watering and adding fertilizers : The growing crop is watered at definite intervals of time. Fertilizers are also added to the soil in the proper quantities. It is useful to take the advice of experts regarding the use of fertilizers. Overuse of water or fertilizers is harmful for plants. Traditionally, crops are watered by channelling water to the

plants. This causes wastage of water. Modern methods like drip and sprinkle irrigation help to save water.

4. Spraying pesticides : Protecting the crop is as important as watering or providing fertilizers. If the crop falls prey to insects or to disease, much grain is destroyed. Germicides, fungicides, insecticides are sprayed to protect the crop. If the chemicals are sprayed to prevent the crop from being attacked by insects or infected by germs or fungii, it is a preventive measure. If the spraying is done on a crop that has already been affected by insects or germs or fungii it is a curative measure.

Care must be taken while spraying the chemicals. If more chemicals are sprayed than necessary, it has harmful effects on the land which becomes infertile over a period of time.

- Name the diseases that affect a wheat crop.
- Name the three types of pesticides sprayed on crops.

Harvesting, threshing and storing

When the crop is ripe, it is harvested at the right time. This helps to gather the maximum possible produce. The harvested cobs of jowar, bajra or maize or ears of rice or wheat are brought to the threshing floor. The crop is threshed with the help of bullocks or a threshing machine. Threshing frees the grain from the cobs or ears. The grain is then winnowed. By winnowing, the husks, chaff and other rubbish are separated and the grain becomes clean.

It is necessary to keep the grain in a good edible condition for a long period of time. For this purpose, it is

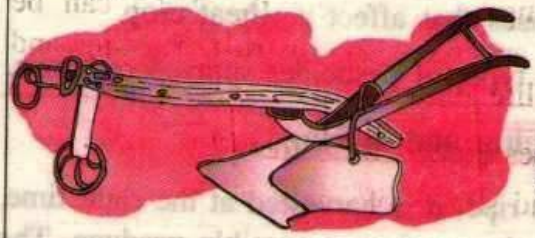
dried completely and stored safely. Generally, large bins made of metal sheets or cement concrete are used for storing grain, so that field rats or mice cannot get at it. These bins are kept in dry rather than in damp places. This protects the grain from insects, fungii and micro-organisms. Neem leaves or even chemicals are used to protect grain. This prevents damage from weevils, beetles and ants. Rice is not husked before storing.

- Name any three pesticides you know of.

Agricultural implements and tools

Several implements and tools are used in agriculture. Also, animals like bullocks, oxen, horses or camels may be harnessed to work these implements.

plough



A plough is used for ploughing the field.

A wooden board is used to even out the ploughed field.

wooden board

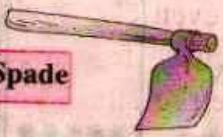
Care of implements

As implements and tools are constantly needed to do farm work, they must be properly taken care of. They come in contact with mud and water all the time. They should be

Seed drills like the *tiphan*, *pabhar* and *mogada* are used for sowing.

Tiphan

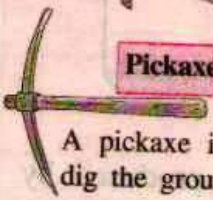
A spade is used to pull and spread soil.



Spade

A spray pump is used for spraying pesticides.

Pump



Pickaxe

A pickaxe is used to dig the ground.

Scythe

A scythe is used for harvesting the crop.

cleaned before putting away after use. They should be oiled regularly. Their blades should be sharpened. They should not be stored in damp places where the wood can be attacked by termites and the iron can rust. Rusting and termites shorten the life of the tools.

- How are mangoes picked from trees ?
- Name two hybrid strains of jowar.

Tissue culture

Growing living cells or groups of cells outside the plant or animal is called tissue culture.

Tissue culture means reproduction in a 'micro' form.

A solid growth medium or a viscous broth is used for growing the cells or tissue. Examples of plants grown by tissue culture are banana and some medicinal plants. The numbers of several plants and animals are falling

day by day while some are becoming extinct. The method of tissue culture can be useful for preserving such plants or to increase their numbers.

By this method, a new organism is produced by growing the cells of a healthy organism in a growth medium under supervision. Thus, the number of plants which give fruits or flowers of good quality can be increased.

When the means of pollination are not available, this method helps to produce a plant like the original one.

Reviewing the Lesson

- Man has been growing plants down the ages. However, plants have always grown and matured in the wild, too.
- Tilling of the land is done in three stages – pre-sowing, sowing and post-sowing.
- When the crop is ready, it is harvested, threshed and properly stored.

- Various tools and implements are used in agriculture.
- Good care must be taken of these tools and implements.

Exercises

1. Answer the following questions.

(a) Besides using plants for food, in which other ways do we make use of plants ?

(b) Write the three stages of the tilling of land in the proper order.

(c) What are the advantages of the pre-sowing tilling activities ?

(d) What are the activities at the post-sowing stage of tilling ?

(e) Explain the difference between 'thinning the crop' and 'weeding'.

(f) Explain the difference between preventive and curative spraying of chemicals.

(g) What is the method used for sowing each of the following crops :

wheat, rice, sugarcane, pumpkin, jowar, cotton.

(h) How many methods are there of sowing seeds ?

2. Match the following.

'A'	'B'
(a) Plough	1. Sowing
(b) Seed drill	2. Weeding
(c) Sickle	3. Ploughing
(d) Scythe	4. Harvesting

3. **Give scientific reasons.**

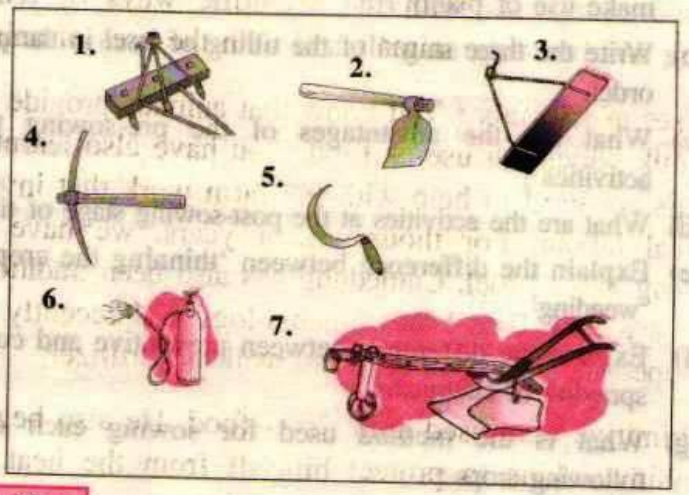
(a) How deep the land should be ploughed depends upon the specific conditions.

(b) The importance of a sickle cannot be judged from its small size.

(c) Farming implements should be stored in dry places.

4. **Write a note on :** Hybridization.

5. **Label the picture given below :**



Activities

(1) Go to a garden nearby and find out from the gardener how he takes care of the garden.

(2) In a vacant plot in your yard, grow some leafy vegetables, following the stages of cultivating a crop.

(3) Find out some information about afforestation.

18. Animal Husbandry

You have learnt how plants meet man's food-related needs. Besides plants, man has been using some animals, too, for food. He also uses animals for several other purposes. For this, he has developed the science of animal husbandry. It deals with the scientific ways of rearing, tending and breeding animals and with the uses of animals.

Uses of animals : You know that animals provide meat and milk which we use as food. You have also learnt that animals are used to help with the farm work that involves physical labour. For thousands of years, we have used cowdung pats as fuel. Cattledung has also been traditionally used as a fuel. The biogas technology has recently been developed to yield both fuel as well as fertilizer.

Primitive man used animals as food. He also began to use animal skins to protect himself from the heat, cold

and rain. Even today, skins of dead animals are used to make many useful articles such as purses, belts, water-skins, a horse's harness, footwear, etc. They are also used to make garments.

Bones of dead animals are also found to be of use. They are used to make fertilizers known as 'bone meal', as also needles, combs and other ornamental articles. The substance separated from bones before making fertilizers is used to obtain glue or gelatine.

Cords made from the gut (intestines) of animals are used to stitch cuts made during surgery. They are also used for making the strings of string instruments. The hair from the manes and tails of pigs and camels are used for making paint brushes. Animal fat is used as food or for making soap, candles, grease and also in the garment industry.

Man has been keeping animals and birds down the ages for a variety of purpose.

In olden times, pigeons were used to carry messages. Even today, animals are used to carry messages in certain special situations.

- For what purpose are dogs kept ?

Animal husbandry : Just like man, food and shelter are the basic needs of animals, too. The arrangements made and means adopted to meet these needs of the animals we keep are included in animal husbandry.

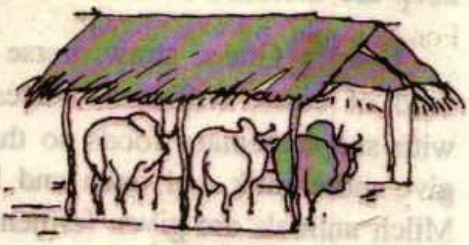
Food : Grass, straw, horse gram serves as the main food of cows, buffaloes, horses. However, these are fed with supplementary foods so that cows and buffaloes can give more milk and oxen and horses can do more work. Milch animals are given fermented fodder or *ambon* every day. *Ambon* is a fermented mixture of oil-cake, grain meal and jaggery. Fermentation increases the nutritive value of the feed. Milch animals are fed oil-cake of cotton seed. Horses are given gram that has been soaked in water. Bullocks are also given *ambon*. These foods make the animals strong and robust.

Animals used for their meat are also given supplementary food just like milch animals and those that do physical work. Pigs are given rice husks, bone meal and leftovers from our food. Goats are given wheat husks, corn, linseed oil-cake. Feed for broilers is available commercially. Generally, **animals need dry feed equal to 2 to 2.5% of their own body weight daily**. For milch animals this figure is higher.

Animals need enough clean water, too, along with food. Animals can get various diseases if they drink contaminated water.

Shelter : Animals must get suitable shelters besides getting food and water. Cattle sheds should be on high

ground, in a dry place, which will also allow water to drain away easily. The area of the shed should be such as to allow animals tied there to move comfortably. The shed floor should be built up and tiled and should have a slope enough to allow urine to flow away. Troughs meant for feeding the animals should be properly built. The roof should give them adequate protection from the sun and rain. Drinking water should be kept close to the shed.



Health : Daily care of domestic animals is necessary to keep them in good health. Their shed should be kept clean. The floor should be regularly washed with germicides to prevent diseases and to protect the animals from flies, fleas and gnats.

As animals tend to get worms, they should be dewormed regularly.

Sheep are particularly prone to getting ticks and lice. Ticks are found on their necks, shoulders and around the anus. They cause wounds and suck

blood. Often, maggots grow in these wounds. Hence, it is important to protect sheep from ticks.

Medicines are not available for some animal diseases. For example, bird flu and Ranikhet diseases cannot be cured. There is also no cure for dogs or other animals who get rabies.

Hence, it is necessary to vaccinate animals properly to prevent such diseases.

If you suspect that an animal is ill, it is best to take it to a veterinary hospital at once for proper treatment. If time is lost, you may lose the animal too.

- Why are milch animals fed cotton seed ?
- Name two vaccinations meant for animals.

Crossbred strains of animals : Technology has been developed for obtaining not only hybrid plants but hybrid strains of animals too. The yield from such animals is greater. The profits are greater.

An Indian cow yields 5-6 litres of milk every day. However, if she is crossed with a Jersey, Holstein or Red Dean bull, the yield from the offspring rises to 10-12 litres daily.

Cows of the Kandhari, Devani, Khilari and Dangi varieties of Maharashtra have been selected for cross-breeding at the national level.

Dangi cow

Kandhari cow

Occupations complementary to agriculture : We keep cows and buffaloes for their milk. We keep bullocks, horses, asses and oxen for doing heavy physical labour, and bullocks, horses and camels for transport. Besides these, we find other animals useful in several other ways, too. As these animals feed mostly on plants, animal husbandry has become a complementary business to farming. It includes keeping sheep, poultry and pigs. Other animal based occupations include sericulture, pearl farming, pisciculture and obtaining lac. Such complementary occupations help to enhance income.

Sheep rearing : A farmer can easily keep sheep as he does not have to incur any expenditure to feed them. Sheep can live on *bor* and *babhul* trees and shrubs that grow wild as also on the stubble and waste of jowar, groundnuts, horse gram, etc. Not only do sheep give wool, meat and skins, but even their droppings give good manure to the fields. Thus, it is profitable for the farmer to keep sheep. One Indian sheep gives one and a half kilograms of wool and 10 to 12 kilograms of meat. The farmer can sell these for a profit. There is more nitrogen, phosphorus and potash in the excreta of sheep than in that of other animals.

Poultry farming : Poultry is kept for both meat and eggs. Different birds are kept for each of these purposes. Hens kept for laying eggs are called layers while those kept for meat are called broilers. Hens that will eat less and lay more eggs are selected as layers. Since no Indian variety of hens meets this requirement, a foreign variety, called the White Leghorn, is used for the purpose. Each hen needs 125 grams of a nourishing diet every day and lays 200-250 eggs in a year. An egg meant for eating is not a fertilized egg, so, there is no possibility of obtaining a chick from it. Such eggs are called table eggs.

Birds kept for meat must have more flesh. They are fed more so that they gain more weight in their fleshy parts. The varieties preferred for this are the Rhode Island Red and the White Leghorn. In a period of 8 to 10 weeks, their weight becomes 1300 to 1500 grams. These birds are preferred for eating.

Obtain information about pig-keeping and discuss it in class. Also, prepare a chart about it and display it in your class.

Pearl culture : Since ancient times, pearls have been considered important. As pearls are used for making ornaments and decorative articles as also in embroidery, they are in great demand. This gives rise to the pearl industry.

Pearls are obtained from a marine animal called 'oyster'. Previously, we depended entirely on nature to obtain pearls. Now, a technique for inserting a grain of sand inside the oyster's body at the right time, has been developed. As a result, large pearls can be obtained on a commercial scale. Such pearls are called cultured pearls. Thus, you can see that cultured pearls are not artificial pearls manufactured in a factory.

The lac industry : You may be familiar with the sealing wax used in offices to seal envelops. This material is called lac. It is also used for making a variety of beads and costume jewellery. The attractive red coloured lac is a material secreted by the lac insect. These insects live on cactii or on the flame of the forest (*palas*) tree. Lac is produced only in India. It is produced because of its commercial value.

Sericulture : Man has learnt to rear the silkworm to obtain the high quality silk fibre that they yield. Sericulture is a profitable business. There are several varieties of silkworm. Of these, the one that lives on the mulberry leaves and the one that eats *ain* leaves are the important varieties. The former yield a very fine variety of silk and the latter yield a silk called tussore silk which is very strong.

The life-cycle of the silkworm is similar to that of the mosquito. The four stages of its life-cycle are egg, larva, pupa and imago (adult moth). It is in the larva stage that the silkworms need the leaves to eat. The salivary gland that opens into the mouth of the mature larva secretes a

sticky substance. The reaction of this substance with air changes it into thread. The larva winds this thread around itself to form a cocoon. The cocoons are boiled in water to obtain silk yarn.

Pisciculture : Down the ages, man has been eating both freshwater and sea fish. Earlier man only caught the fish that were available in nature. Now, the desired variety of fish are grown from their 'seeds' in the sea or in other water bodies and are used for eating. The government makes good quality fish seed or spawn available for the purpose. Fish are included in sea foods. Some fresh water fish are *katla*, *rohu*, *mrugal*, and carp while some sea fish are *boi* (mulletfish), *muddushi* (shellfish), *renavi* and *khasi*.

Reviewing the Lesson

- Man uses animals for food and for doing heavy physical labour besides some other purposes.
- Animal husbandry involves meeting the basic needs of animals we keep.
- Animal husbandry includes sheep rearing, poultry farming, pearl culture, the lac industry, sericulture, pisciculture, etc.

Exercises

1. **Give scientific reason.**
   (a) Milch animals are fed on *ambon*.
   (b) Horses are given horse gram as supplementary food.

(c) Pigs are fed rice husks and chaff and bone meal.

(d) A cattleshed is kept clean.

2. Answer the following questions.

(a) In what way are lice and ticks a nuisance for sheep ?

(b) What are the occupations included under animal husbandry ?

(c) What are the differences between layer and broiler birds ?

3. Name the following.

(a) Incurable animal diseases.

(b) The animal that grows a pearl.

(c) The main crop required for sericulture.

4. Write notes on –

(a) Crossbred animals

(b) Sheep rearing

(c) Pisciculture

(d) Cultured pearls

Activity

- Visit any place where animals are reared and find out about animal diseases.

Appendix - 1

Answers to Some Questions in the Text

1. Stars and Our Solar System

- Why should we not cut lanes when driving ?
- If, like the planets, we keep to our lanes, we will avoid road accidents.

- The earth revolves around the sun. Can it be called a satellite of the sun ?
- A satellite is a body that revolves around a planet, not around a star. Hence, the earth is not a satellite of the sun as the sun is a star.

- Why is it difficult for us to see Mercury because of its being on the horizon ?
- Being very close to the horizon at sunrise or sunset it is often hidden behind buildings, mountains, etc and cannot be seen. But, we can see it in open places, where there are no obstacles in the way.
- What would happen if the earth were to pass through the tail of a comet ?
- When the earth passes through a comet's tail, meteor showers are seen. This is a very attractive sight. Innumerable meteors are seen in the sky.

2. Biological Diversity

- What is the special feature of the musk deer ?

◈ A scented substance called musk is found in the musk deer's navel. It has medicinal uses.

■ What priceless treasure do adivasis possess ?

◈ Adivasis have a treasure of traditional knowledge about plants and animals. It is important to preserve this knowledge. Otherwise, in the course of time, this knowledge, and biological diversity with it, will all be lost.

3. Atmospheric Pressure

■ Why do school bags have broad shoulder straps ?

◈ The broad shoulder straps help to spread the weight of the bag over a wider area. This reduces the pressure acting on the shoulders.

■ Why do our ears ache when we travel by an aeroplane ?

◈ While travelling by air, the pressure of the air surrounding us changes. As the plane lands, it loses height rapidly and air pressure increases. The increased pressure on the eardrum causes an ear ache.

■ Why do we pucker our lips when blowing out a candle ?

◈ On puckering our lips we reduce the area through which air escapes, thus increasing its pressure. The air blows harder and puts out the flame.

4. Magnetism

■ A bar magnet was placed deep inside a sack of coal. Fine particles of coal got stuck to it. From this, can we infer that coal is attracted towards a magnet ?

◈ The coal particles do not stick because of magnetic properties, but because of the adhesive force existing between any two surfaces in contact.

5. The Structure of an Atom

■ Is the structure of the atom the same as the structure of the solar system ?

◈ It cannot be said that atomic structure is the same as the structure of the solar system. The only similarity is that electrons revolve around the nucleus just as planets revolve around the sun.

■ The planets of the solar system revolve around the sun due to gravitational forces. Which force acts in the atom ?

◈ The attraction force between the positively charged nucleus and the negatively charged electrons.

■ What is the function of the neutrons in the nucleus ?

◈ The neutrons keep the protons, which have like positive charges, bound within the nucleus.

■ Why are atomic numbers and atomic mass numbers always whole numbers ?

◈ Atomic number and atomic mass number give us respectively, the number of protons and of protons and neutrons together. Hence, they are always whole numbers.

■ The gas argon does not take part in chemical reactions.

What do you think is its valency ?

◈ Its valency is zero.

6. Chemical Reactions and their Types

■ Is burning always an exothermic reaction ?

◈ Yes.

■ Is the action of dissolving of a substance always an endothermic reaction ?

◈ No.

7. The Structure of a Cell and Micro-organisms

■ How many chromosomes are there in the nucleus of the human cell ?

◈ The nucleus of the human cell has 46 chromosomes.

■ Why is the euglena said to belong to both the animal as well as the plant kingdom ?

◈ The euglena shows behaviours like an animal. However, since it has chlorophyll, it is an autotrophic organism. Hence, it is said to belong to both the classes of living things - plant and animal.

8. Diseases

■ Which vaccine did Edward Jenner discover ? What prompted this discovery ?

◈ He discovered the vaccine for smallpox. The beliefs of some cowgirls regarding the rash that appeared on their arms prompted this discovery.

■ What instructions are given by the Health Department during the rainy reason ?

◈ The Health Department gives the following instructions : (1) Drink boiled water. (2) Take vaccines of epidemic diseases. (3) Do not eat stale food or food left uncovered. (4) If you fall ill, get medical treatment. (5) Do not allow water to stagnate around the house.

■ Do we get AIDS by shaking hands with an AIDS affected person ?

◈ No, we do not get AIDS by shaking hands.

9. Reflection of Light

■ Why is the candle in the mirror not called an object ?

◈ An object has its own physical existence. An object is a real body. If you move it, the image, too, moves. However, when you move the mirror, the image moves but the object does not.

■ If we were to hold the candle upside down, what would its image be like ?

◈ The image would be upside down, too.

■ Why is the word 'ambulance' written on an ambulance as ƎɔИAJUBMA ?

◈ It is written like this to enable a driver to recognize an ambulance following him/her by looking in the rear view mirror. The inverted word gets inverted again and can be read as usual.

■ How should a ray of light be incident on a mirror

placed at right angles to the floor in order that the reflected ray comes downwards ? Which plane will contain these two rays and the normal ?

◈ Downwards, obliquely. The plane containing the incident and reflected ray and the normal will all be in one and the same plane.

■ Are the laws of reflection followed when irregular reflection takes place ?

◈ Yes.

■ Why is the surface of a glass made shiny when making a mirror ?

◈ All light is reflected from a shiny surface and we get a clear image.

10. Source of Energy

■ What happens to the solar energy absorbed by water ?

◈ Aquatic life survives because of this energy.

■ Why do renewable sources of energy not cause pollution ?

◈ When renewable sources burn they do not produce polluting substances. Hence, there is no threat of pollution.

11. Electric Current

■ When an electric current flows, what is the direction of motion of electrons ?

◈ In the dry cell the electrons flow from the zinc electrode towards the carbon rod.

■ What is an insulation tape made from ?

◈ It is made of any of the insulating materials – cotton, plastic or rubber.

12. Properties of Substances

■ Which methods will you use to obtain salt from the sea water in salt pans – evaporation or distillation ?

◈ Evaporation.

■ Which salt is obtained as a result of the chemical reaction between hydrochloric acid (HCl) and sodium hydroxide (NaOH) ? Which method will you use to separate it from the solution ?

◈ Sodium chloride. Distillation.

13. Metals and Non-metals

■ What is the size of the sheet you can get from 1g gold ?

◈ A sheet of area $2m^2$, obtained from 1g gold, is the record.

■ How do we clean silver or brass articles that have got tarnished ?

◈ We use tamarind. The tartaric acid in tamarind helps to remove the stains.

14. Carbon and Carbon Compounds

■ What common feature is there in sugar, paper, plastic, wood, cereals, pulses and petrol ?

◈ They are all compounds of carbon.

■ Why is charcoal used as a domestic fuel ?

◈ It does not smoke while burning.

■ Is carbon dioxide always formed when a hydrocarbon is burnt ?

◈ Yes.

■ What is the difference between methane and the gas in the cylinder we use at home ?

◈ The gas in the cylinder is butane. It has been liquefied under pressure. Methane cannot be compressed.

15. Air

■ About a hundred years ago, the proportion of carbon dioxide in air was about 0.029%. Today it is 0.035%. What is the reason ?

◈ The fuel burnt in the increasing number of factories causes a continuous rise in the proportion of atmospheric carbon dioxide.

■ Why does an electric light burn even when there is no oxygen in the bulb ?

◈ The filament (fine wire) in the bulb does not burn. It gives out light because it becomes incandescent.

■ How does carbon dioxide cause global warming ?

◈ Because of carbon dioxide, heat, instead of being given out, is trapped in the atmosphere and atmospheric temperature rises. This is called global warming.

- What dangers will we have to face if the proportions of oxygen and nitrogen in the air undergo a change ?
- If the proportion of oxygen increases there is the danger of fires. If nitrogen increases there is the danger of suffocation.
- What is the use of atmospheric ozone ?
- Atmospheric ozone stops the harmful rays from the sun and prevents them from reaching us.

16. Soil

- What is meant by terra cotta ? What are its uses ?
- Terra cotta means baked earth. Earth is used to make earthenware articles like pots, etc. Once these articles have been baked, it takes many years for them to change back into soil. In a way, it degrades soil.
- Which crops are grown in sandy soil ?
- Cucumbers, muskmelon, watermelon, fenugreek are some crops grown in sandy soil.

17. Agriculture

- Name the diseases that affect a wheat crop.
- Wheat is affected by a fungus called rust.
- Name the three types of pesticides sprayed on crops.
- Crops may be sprayed with germicides, insecticides and fungicides.

■ Name any three pesticides you know of.

◈ Gammaxane powder, rogor, endrine, etc are some pesticides.

■ Name two hybrid strains of jowar.

◈ 'Vasant' and 'Swati' are the names of hybrid strains of jowar.

18. Animal Husbandry

■ Why are milch animals fed cotton seed ?

◈ Cotton seed is rich in fat and protein. This helps to increase the yield of milk and make it more nourishing.

■ Name two vaccinations meant for animals.

◈ The vaccines for protection from the diseases called the 'foot and mouth disease' and 'foot rot'.

Appendix - 2

List of Experiments

1. To study the variation in the size, shape, body parts of various animals, for example, fish, squirrel, parrot, and the amoeba (on a slide).
2. To study the variation in the size, shape and parts of plants, for example, grass, fenugreek, radish, aloe.
3. To study the effect of pressure exerted by solid, liquid and gaseous substances.
4. To study the effect of pressure on fluid substances.
5. To identify the type of a given magnet.
6. To study the attraction and repulsion properties of a magnet.
7. To study a combination reaction.
8. To study an endothermic reaction.
9. To study an exothermic reaction.
10. To observe a plant cell under a microscope using a permanent slide.
11. To observe an animal cell under a microscope using a permanent slide.
12. To study how drinking water should be boiled, filtered and stored properly.
13. To study the laws of reflection.

14. To study how an electric current flows using a dry cell, bulb and conducting wires.

15. To study the structure of a dry cell.

16. To learn to recognize a cell, bulb, key and wires and the symbols used to represent them.

17. To separate common salt and water from their solution by distillation.

18. To observe, by burning a magnesium ribbon, that metals combine with oxygen.

19. To study the different types of coal.

20. To study the relationship between the types of soil, the size of its particles and its water-holding capacity.